

Assessing the Spatial–Temporal Relationship Between Disorder and Violence

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Abstract The relationship between disorder and violence has generated much debate in the field of criminology. While advocates of the broken windows thesis believe disorder is the root cause of crime, other researchers view both disorder and crime as analogous behaviors resulting from the breakdown of collective efficacy. Scholars from both sides of this debate, however, assume a long-term correlation between disorder and crime at places. This assumption has not been tested with a longitudinal dataset at a relatively small geographic unit of analysis. The current study used data collected in Seattle, Washington and utilized Group-based Trajectory Analysis and Joint Trajectory Analysis to explore the longitudinal relationship between disorder and violence. The results showed that disorder, just like crime, concentrates in a few “hot spots.” Additionally, the results showed that while the lack of disorder problems guarantees places to be violence free, having high levels of disorder predicts having violence problems only about 30% of time. As such, these findings point out the need for future theorization efforts on the disorder-violence nexus to include contextual factors which could explain this imperfect association between the two.

Keywords Disorder · Violence · Broken windows · Longitudinal

A city isn't just a place to live, to shop, to go out and have kids play. It's a place that implicates how one derives one's ethics, how one develops a sense of justice, how one learns to talk with and learn from people who are unlike oneself, which is how a human being becomes human.

—“The Civitas of Seeing” Richard Sennett (1989)

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Introduction

Disorder is a part of the urban landscape. Urban sociologists have been studying the meanings of disorder in cities for nearly half a century. Sociologist Richard Sennett (1970), who grew up in one of the country's first racially mixed housing projects, believes that disorder is a manifestation of the urbanization and heterogeneity of modern cities. Criminologists, however, ignored the role of disorder until Wilson and Kelling (1982) published their seminal "Broken Windows" piece in *Atlantic Monthly*.

Wilson and Kelling see disorder from a very different perspective than Sennett. They suggested that untended disorder in urban areas causes more serious problems and that police could best fight crime by focusing attention on reducing disorder. This idea has stimulated an unprecedented amount of attention on disorder from scholars, criminal justice practitioners and urban residents and led to the creation of a widely publicized police strategy—broken windows policing.

Broken windows policing was credited for the crime reduction in New York City in the 1990s under Police Commissioner William Bratton (see Kelling and Sousa 2001; Kelling and Coles 1996; Greene 1999 for discussions). This intuitive idea that minor problems and nuisances in urban areas generate crime is appealing to both practitioners and the general public. Police have embraced the broken windows thesis seriously, with the aforementioned quality-of-life policing effort in New York City as the best-known example (see Kelling and Sousa 2001; Bratton and Kelling 2006; Kelling and Coles 1996; Sousa and Kelling 2006; Weisburd and Braga 2006). Many police departments around the globe have since adopted broken windows style policing, quality-of-life policing, or "Zero Tolerance" approaches (Dennis and Mallon 1998). Similarly, researchers from various fields such as criminology, economics, urban planning and political science have also examined the potential implications of disorder and its relationship to other social phenomena (e.g., Corman and Mocan 2000, 2005; Giacomassi and Forde 2000; Sampson and Raudenbush 1999; Skogan 1990; Taylor 1999; Thacher 2004; Wilson and Kelling 1982; S. Brower, Unpublished Manuscript).

Despite the popularity of the broken windows thesis among practitioners, there are different interpretations of the core principle of the thesis—the relationship between disorder and crime (Sampson and Raudenbush 1999; Harcourt 2001; Bratton and Kelling 2006; Sousa and Kelling 2006; Xu et al. 2005). While Wilson and Kelling (1982) proposed a causal relationship where untended disorder started a chain of events that could lead to more serious crimes, Sampson and Raudenbush (1999) argued that disorder and crime are analogous behaviors and merely co-exist at places over time. Thus they contend that the association between disorder and crime is simply spurious. The disagreement between these two perspectives has resulted in a long-lasting debate over whether the relationship between disorder and crime is causal or correlational.

However, when we scrutinize these arguments, the differences between the two perspectives do not seem to be as irreconcilable as they appear at first glance. First of all, scholars on both sides of this debate believe in the importance of social control in preventing crime problems. Wilson and Kelling believe untended disorder starts a process which eventually can erode social control and leave areas vulnerable to criminal invasion, while Sampson and Raudenbush (1999) believe disorder and crime are both simply manifestations of low levels of collective efficacy (i.e., an aspect of informal social control).

Secondly, both perspectives believe that signs of disorder, be it unsupervised teens in the corner of a street (Sampson and Groves 1989, p. 778) or an abandoned car or public

intoxication (Wilson and Kelling 1982; Kelling and Coles 1996), are evidence of a lack of social control in a community; though the implications of having disorder are very different for each perspective. The broken windows thesis argues that presence of disorder increases fear of crime and thus erodes social control, while the collective efficacy perspective suggests that having a high level of disorder is merely an outcome of low collective efficacy.

More importantly, both perspectives agree that disorder and crime are related to each other at places and that the relationship will remain as long as the root cause leading to the relationship is not addressed. They simply disagree on the *type* of relationship between disorder and crime, and on the functions that disorder plays at places. In other words, while Wilson and Kelling and Sampson and his colleagues do not agree on *how* disorder is linked to crime in their work, they nonetheless agree that there is a longitudinal relationship between disorder and crime. While the belief that disorder and crime at places are related over time is accepted by both the proponents and the opponents of the broken windows thesis, it is an assumption that exists without empirical confirmation from longitudinal data sets.

The main purpose of the current study is to provide new and more refined evidence on this knowledge gap by examining the longitudinal relationship between crime and disorder using two comprehensive datasets, which cover observations for 16 years at relatively small geographic places. These data are unique due to their length of data coverage and the detailed information recorded regarding violence, social disorder and physical disorder. The current study also uses recent advances in longitudinal research techniques, Group-Based Trajectory Analysis and Joint Trajectory Analysis, to examine the longitudinal data collected in Seattle and explore the associations between disorder and violence. Another unique feature of this study is that it examines the independent effects of social disorder and physical disorder on violence. By not treating disorder as a global concept, research on disorder can benefit from the ability to examine potential differential effects of the two types of disorder on violence.

Disorder and Crime

Compared to other types of crime (e.g., violent crime or property crime), disorder is generally considered minor on the continuum of crime seriousness (see Wolfgang et al. 1985). Mirroring its position on the crime severity scale, disorder had always taken a minimal or marginal role in criminological research (Shaw and McKay 1942; Shaw et al. 1929; Bursik and Grasmick 1993; Sampson and Groves 1989; except for Garofalo and Laub 1978; Wilson 1968, 1975) until Wilson and Kelling (1982) published the broken windows thesis. Drawing on Zimbardo's (1969) field experiment, Wilson and Kelling suggested that disorder leads to an increase in serious crimes through the following mechanisms.

First, when disorder goes unintended, such as trash on a street or panhandlers approaching passersby, residents perceive the problems and become fearful. The signs of disorder cause both residents and would-be offenders to conclude that the level of social control in the area is low; consequently, residents withdraw from the community out of fear and those would-be offenders invade the area with criminal activities. Based on the broken windows thesis, it is fair to conclude that disorder is regarded as a root cause of urban crime problems.

Wesley Skogan shares a similar belief about disorder. In his book *Disorder and Decline*, Skogan (1990) defines the content of disorder and suggests that incivilities will lead to more criminal victimization, residents' dissatisfaction and changes in neighborhood structure, with the ultimate consequence being the decline of neighborhoods. With the limitation of having a small sample size, however, Skogan could only conclude that it is hard to tell "whether they have either separate 'causes' or separate 'effects' at the area level" (1990, p. 73).

Another perspective believes that the relationship between disorder and violence (or other types of crime) is merely spurious (e.g., Sampson and Raudenbush 1999, 2001; Harcourt 1998, 2006; Geller 2007; Taylor 2006). That is, disorder and violence relate to each other over time simply because the same underlying causes drive the occurrence of both types of problems. Among those arguing this point, Sampson and Raudenbush published the most widely cited piece challenging the broken windows thesis in 1999. Using cross-sectional data collected during the Chicago project (PHDCN, see Sampson et al. 1997), Sampson and Raudenbush argued that the connection between disorder and crime is not causal and that the relationship disappears after controlling for other structural factors and collective efficacy (except for robbery). They concluded that disorder and crime "share similar theoretical features and are consequently explained by the same constructs..." (p. 636). As such, the relationship observed between the two is a result of the levels of collective efficacy at places (also see Harcourt 2001; Harcourt and Ludwig 2006).

Setting aside the debatable causal connection between disorder and crime, both sides of the debate actually agree upon one thing—that disorder and crime *should* be related to each other at places, *and*, over time.¹ This seemingly reasonable statement, however, has not been thoroughly examined with empirical data. One important reason for this knowledge gap is the lack of longitudinal data on both crime and disorder. The lack of longitudinal data prevents Sampson and Raudenbush (1999) from properly testing the sequential relationship suggested by the broken windows thesis.

The closest to a full longitudinal test of these ideas to date was Ralph Taylor's panel study in Baltimore, Maryland.² Using 562 street block faces from 66 randomly selected neighborhoods in Baltimore, Taylor (1999) found that initial levels of incivilities had impacts on crime, fear and neighborhood decline, but after controlling for neighborhood structures, the associations disappeared. As this study examined the relationship between disorder and crime with data collected at two time points measured 13 years apart, the nature of the data did not allow Taylor to draw conclusions about the relationships between disorder and crime over time.

The current study improves upon this by focusing on understanding the *type* of long-term relationship between disorder and crime across places. Thus, the main purpose of this study is to examine whether the assumed correlations between disorder and crime exist over time. In addition to the advantage of using longitudinal data to examine the relationship between the two phenomena, this study provides other strengths which will add to our understanding of the crime-disorder nexus.

¹ People who are interested in the debate can refer to Sousa and Kelling (2006). This debate, however, is not the central focus of this paper and will not be discussed here due to space limitations.

² Corman and Mocan (2000) also examine the association between misdemeanor arrests and crime rate in NYC over time. However, they did not measure disorder directly; rather, they used misdemeanor arrests as a proxy of disorder. Geller (2007) examines housing conditions and their relationship to crime rates in NYC. But only physical disorder was used in the study.

First, this study uses both Group-Based Trajectory Analysis (GBTA) and Joint Trajectory Analysis (JTA) to capture the developmental patterns of disorder and violence over time. Second, the study uses census block groups, a relatively small geographic unit, to study the phenomena.³ In the following section, the rationales of using census block groups as the unit of analysis will be elaborated upon further. Third, this study uses data collected by two different agencies in Seattle, Washington from 1989 to 2004. The use of multiple data sources allows the cross-validation of information.

One important aspect of this study is its ability to explore the concentration of disorder in an urban city over time. It has been widely established that crime only concentrates at a small number of places (Sherman et al. 1989; Sherman and Weisburd 1995; Weisburd et al. 2004a). Yet, the geographic distribution pattern of other social illnesses such as disorder is not fully understood. Are there also “hot spots” of disorder in an urban city, like what was found in the crime hot spots literature? With the availability of two independent data sources, this study can provide a more comprehensive sketch of how disorder distributes across places.

Finally, another important contribution of this study is to differentiate between two distinct but often mixed phenomena—social disorder and physical disorder. From a research standpoint, social disorder and physical disorder are qualitatively different. Sampson and Raudenbush (1999) clearly pointed this out: by “[s]ocial disorder, we refer to behaviors involving strangers and considered threatening...”, and by “[p]hysical disorder, we refer to the deterioration of urban landscapes” (pp. 603–604). One key element of social disorder is the presence of actors who perform offensive actions. The presence of social disorder perhaps provides a greater level of anonymity and an easy convergence of potential targets, motivated offenders or both for violent offenses to occur. Physical disorder, however, does not necessarily involve actors as it represents a more objective condition characterizing what disorganized places look like (as seen in Shaw and McKay 1942). In Zimbardo’s (1969) original study, physical disorder (such as an abandoned car) was viewed as a trigger to subsequent disruptive behaviors. Due to the fundamental differences between the two, social disorder and physical disorder should affect the development of crime differently.

In terms of the duration of the event, social disorder is usually an episodic behavior, which only lasts for a limited amount of time. Physical disorder, on the other hand, may last for a long period of time unless some actions are taken to change it. As such, it provides unmistakable visual cues to users of the space. Therefore, residents’ perceptions of physical disorder should be more consistent than their perceptions of social disorder as the latter involves more value judgments. The link between resident’s perceptions of disorder and crime, though important, is beyond the scope of this paper (J. C. Hinkle and S.-M. Yang, in progress). In-depth discussions regarding this issue can be found in Sampson and Raudenbush’s (2004) and Gau and Pratt’s (2008) works.

Past studies have proposed clear definitions regarding social and physical disorder, as well as the characteristics included within each (Sampson and Raudenbush 1999; Skogan and Maxfield 1981; Skogan 1990; Taylor 2001; LaGrange et al. 1992). However, few of these studies actually examined the independent effects of the two types of disorder empirically. Instead, past research has tended to collapse both types of disorder into an overall measure of total disorder (see St. Jean 2007 for an exception). Ignoring the differences between social disorder and physical disorder could dilute the actual impact of

³ A block group is smaller than a census tract and larger than a census block. Generally, a census tract can be divided into about 4 block groups (at most 9 block groups) depending on the size of population within each block group (Census Bureau 1994).

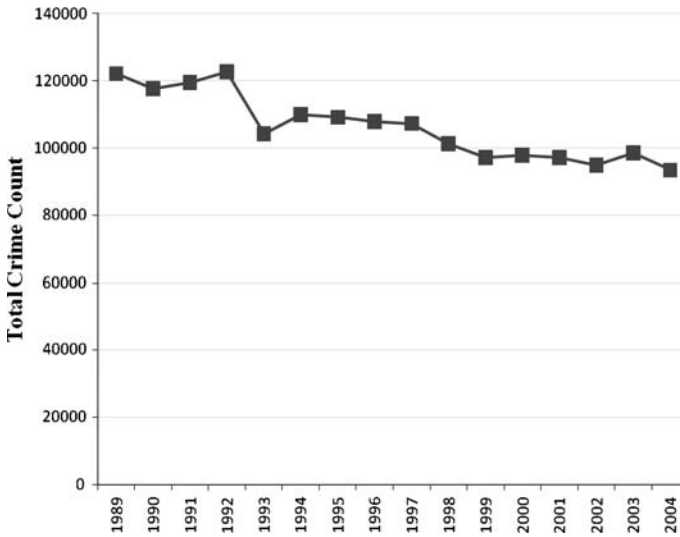


Fig. 1 Seattle crime trend (including all crimes)

disorder on crime, if the effect indeed varies by the type of disorder in question. To address this issue, this study uses two separate data sources to represent social and physical disorder and assesses the independent relationship of each to violence.

This Study

To understand the longitudinal patterns between disorder and violent crime, information was collected from Seattle, Washington. Seattle was a logical choice as it has a level of crime occurrences that is substantial enough for this study to be meaningful (see Fig. 1). Across an area of 84 square miles, Seattle has 8,091 crimes per 100,000 people, higher than the average crime rate of other cities with similar populations in 2004 (Federal Bureau of Investigation 2006).

Compared to most American cities with populations of over 200,000, Seattle is a fairly heterogeneous city in terms of racial composition. According to the 2000 US Census, Seattle has a population of 563,374 and is ranked as the 22nd most populous city in the country. According to the 2000 Census, Seattle's population is 70.1% Caucasian, 8.4% African American, 5.3% Hispanic, and 13.1% Asian. Asians are overrepresented in Seattle compared to other cities (3.64% of the entire US population is Asian, Census Bureau 2002).

Seattle is located on the west coast of the United States. It is bounded on the west by the Puget Sound and on the east by Lake Washington. The southern section of the city is split northwest to southeast by the Duwamish Waterway. The northern section of the city is split from the central by a waterway consisting of Salmon Bay, Lake Union, Portage Bay, and Union Bay. Seattle is a well-planned and developed city. The early blueprint of the city's green land and parks were largely sketched by John Charles Olmsted in the early 1900s.⁴

⁴ For more information about Seattle's park history, see <http://www.seattle.gov/parks/parkspaces/olmsted.htm> (Retrieved on 26 Oct 2009).

Like some other big cities in the U.S., Seattle is also concerned about the issue of order maintenance. In the past, the Seattle City Council passed an ordinance proposed by City Attorney Mark Sidran who banned sitting on sidewalks in downtown Seattle and in neighborhood commercial areas between 7 am and 9 pm. The ordinance was proposed as a tool to control the homeless population of Seattle in an effort to attract more would-be consumers. Similar to reactions seen in other cities (McArdle and Erzen 2001; Erzen 2001), this ordinance has been brought to court several times by citizen advocates. The Ninth Circuit Court of Appeals ruled it to be constitutional. However, this issue is still unsettled in Seattle (Kelling and Coles 1996). Thus, choosing Seattle as the study site has both practical and substantial meaning to the understanding of the implications of disorder in an urban city.

Data and Methodology

One unique benefit that Seattle provides is the availability of longitudinal crime and disorder data.⁵ Having 16 years of data collected at the census block group level allows for a meaningful test of the relationship between disorder and violence. Below each data source and their strengths and weaknesses will be reviewed.

Violent Crime

The violent crime data were drawn from the crime incident database collected by the Seattle Police Department. Crime incident report data provide a middle ground as a balance between inclusiveness (i.e., calls for service data) and accuracy (represented by arrest data) of data.⁶ Thus, incident data are used in this analysis as the primary measure of violent crime and social disorder. With respect to the classification of violence, this study follows the official definition of violent crime and includes the following types of offenses in the violence measure: aggravated assault, non-aggravated assault, homicide, kidnapping, drive-by shooting, rape, robbery, and sexual offenses. It is important to note that the Seattle Police Department uses specific codes to indicate domestic violence related events or violations of protection orders. Thus, those events (over 20,000 cases) were not included in the measure of violence in this study.

This study focuses on violent crime as opposed to general crime for two reasons, due to both empirical evidence and logical justifications. First, Sousa and Kelling (2006) acknowledge that not all types of serious crime are outcomes of disorder (p. 87). From empirical grounds, past studies (both those supporting and those challenging the BW thesis) tended to find a significant association between disorder and violent crime rather than with general crime, regardless of how disorder was measured (Weisburd et al. 1992; Sampson and Raudenbush 1999, 2001; Kelling and Sousa 2001; Rosenfeld et al. 2007; St. Jean 2007). In one of the key studies which found supportive evidence for the broken windows thesis, Kelling and Sousa (2001) also argued that violent crime would be the most anticipated outcome of unintended disorder problems.

⁵ The Seattle Police Department has kept detailed crime data since the 1980s. Although due to data format issues, only data after 1989 are available in computerized format (see Weisburd et al. 2004 for a detailed discussion of this issue).

⁶ See Lum (2003) for an in-depth discussion of data sources available from Seattle.

Another reason for selecting violence over general crime is to avoid a tautological problem. Certain types of disorder (like graffiti and vandalism) are qualitatively similar to property crime in that both involve damage of physical objects or environments. Thus, studying effects of disorder (which sometimes involves property damage) on general crime (of which property crime makes up the majority) is like using one behavior to predict itself (Gau and Pratt 2008). On the contrary, disorder and violence occupy two extremes of the crime severity spectrum with disorder on the least severe end and violence on the most severe end (Wolfgang et al. 1985; Warr 1989). Thus, studying these two qualitatively different behaviors minimizes the tautological problem. An additional benefit of using violent crime stems from data quality. Violent crime usually has a higher reporting rate than other types of crime and is generally considered as more reliable (Mosher et al. 2002). As such, this study chose to focus on the association between disorder and violence, rather than crime in general.

Social Disorder

Social disorder incidents were also drawn from the crime incident database collected by the Seattle Police Department. Over the 16 years of observation, there were 175,405 social disorder incidents reported in Seattle. Social disorder generally refers to behaviors that are considered threatening by other people or defined as public moral offenses which tend to result in police reactions such as prostitution, gambling, indecency, public drunkenness, narcotics arrests and disturbing the peace (Sampson and Raudenbush 1999; Skogan 1990; Weisburd and Mazerolle 2000). Summarizing from past research, the social disorder measure includes the following items: disorderly conduct, noise, alcohol and public drinking, gambling, drug-related offenses (not including large scale drug trafficking), and prostitution. Thus, the social disorder measure represents events that were perceived as bothersome by citizens and also substantiated by police.

Physical Disorder

The locations and frequency of physical disorder incidents were collected by Seattle's Public Utility Department. Physical disorder usually refers to the deterioration of the urban landscapes (Sampson and Raudenbush 1999). The physical disorder measure in this study includes: illegal dumping, litter,⁷ graffiti, weeds, vacant buildings, inoperable cars on the street, junk storage, weeds, zoning violations, exterior abatement, substandard housing and minor property damage. The information came from various sources including different city agencies,⁸ inspectors' reports, and citizen's complaints. Citizens can file complaints through a hotline via email or phone calls. Therefore, this database covers information from a wide range of sources and thus reflects both an objective measure and citizens' perceptions of physical disorder.

Seattle's Public Utility Department started their systematic data collection effort in 1993. Thus, the analyses in this study involving physical disorder incidents cover the time

⁷ The type of dumping and litter items recorded in the database consists of items such as tires, appliances, yard waste, mattresses, and freezers to list just a few.

⁸ In the database, several agencies have been identified to be main sources of information including Department of Corrections, Citizens Service Bureau, Police Department, Parking Enforcement, city council, and Health Department.

Table 1 Descriptive statistics of violence, social disorder and physical disorder

	Violence				Social disorder				Physical disorder			
	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	Mean	Mean	Max
1989	23.84	40.275	0	476	19.41	34.128	0	471	N/A	N/A	N/A	N/A
1990	24.62	44.926	0	606	18.74	32.595	0	483	N/A	N/A	N/A	N/A
1991	24.43	42.217	0	609	19.77	35.475	0	602	N/A	N/A	N/A	N/A
1992	24.18	42.682	0	619	20.08	37.781	0	613	N/A	N/A	N/A	N/A
1993	24.39	44.157	0	623	20.34	41.979	0	729	3.81	3.81	3.81	47
1994	22.96	38.393	0	534	19.85	38.153	0	688	4.34	4.34	4.34	45
1995	22.57	40.937	0	559	20.34	39.483	0	606	6.00	6.00	6.00	23
1996	20.60	37.478	0	582	19.47	41.047	0	704	6.24	6.24	6.24	31
1997	20.13	37.049	0	583	18.24	39.344	0	672	6.82	6.82	6.82	50
1998	19.23	34.073	0	525	17.71	36.168	0	621	5.86	5.86	5.86	35
1999	17.22	31.062	0	451	18.09	33.936	0	516	5.17	5.17	5.17	70
2000	16.98	29.264	0	397	19.22	35.930	0	514	5.09	5.09	5.09	26
2001	16.02	27.845	0	355	19.28	33.202	0	434	4.71	4.71	4.71	35
2002	15.56	25.935	0	326	18.65	36.103	0	471	5.05	5.05	5.05	33
2003	15.36	25.383	0	334	19.74	35.277	0	499	5.11	5.11	5.11	40
2004	15.66	28.275	0	387	19.34	34.083	0	447	4.56	4.56	4.56	N/A

period from 1993 to 2004. In total, 35,708 physical disorder incidents were analyzed in the current study.

As noted above, scholars have questioned the discriminate validity between disorder and crime and argued that they are both crime in nature but vary in terms of level of severity (see Gau and Pratt 2008). As such, some have argued that the high correlation between the two is not meaningful. Thus, using physical disorder data in this study circumvents this problem by providing a more objective measure that is related to the physical condition of places but generally not considered as a minor crime like social disorder.

The descriptive information including means, standard deviations, minimum values and maximum values of violence, social disorder and physical disorders of the block groups by year is presented in Table 1.

Unit of Analysis

This study uses census block groups as the unit of the analysis to examine the association between disorder and violence over time. The choice of a proper unit of analysis is important, especially to a place-based study (Weisburd et al. 2008; Bailey and Gatrell 1995; Groff et al. 2008). Bailey (1985) also demonstrated that different units of analysis can lead to findings of different relationships in a study.

The census block group is chosen in this study for both theoretical and methodological reasons. First, it allows for an examination of the phenomenon in a relatively small geographic unit. Prior studies focusing on disorder tended to use a larger geographic aggregation such as cities (Skogan 1990), neighborhood clusters (Sampson and Raudenbush 2001),

police boroughs (Kelling and Sousa 2001), or census tracts (Sampson and Raudenbush 1999). The few exceptions are Taylor's (2001) study using block faces in Baltimore and Reisig and Cancino's (2004) study examining the patterns of residential units.⁹

The unit of analysis is important because aggregation of data at a large geographic unit may mask variability that would have otherwise been observed in a micro unit (see Weisburd et al. 2004a, b; E. R. Groff et al., forthcoming). The census block group is a relatively small unit of analysis compared to most of the prior disorder research. As such, it provides a more focused view of how disorder and violence are associated at places over time. Meanwhile, a census block group is large enough to allow the formation of social control to happen yet small enough to reveal the variations of crime across places.¹⁰

Secondly, prior studies have found census block groups to be a meaningful unit for analysis of crime. Studying crime and social problems, Aronson et al. (2007) found substantial variability at the census block group level regarding the physical and social conditions. Walsh and Taylor (2007) also argue that the boundaries of census block groups align with many interpersonal and control-related dynamics. Additionally, Tita et al. (2005) found clear distinctions between gangs' set locations in Pittsburgh, PA at the census block group level.

The census block group is also adjusted for the number of households within an area. According to the U.S. Census' guidelines, an ideal size for a block group is 400 housing units, with a minimum of 250 and a maximum of 550 housing units (Census Bureau 1994). The block group boundaries are also drawn to follow clearly visible features, such as roads, rivers and railroad tracks (Census Bureau 1994, pp. 11-9). Therefore, the analysis of crime patterns based on aggregation at the census block group level should take into account the effects of population density while also considering the effects of natural boundaries.

According to the 1990 census, Seattle has 579 census block groups with sizes ranging from 0.02 square miles to 2.48 square miles with an average size of 0.147 square miles (standard deviation 0.172). Due to data restrictions, the analysis excluded nine block groups.¹¹ The final sample consists of 570 census block groups for the full analysis.

Methods

To explore the longitudinal relationships between disorder and violence in Seattle, two methods were chosen: Group-Based Trajectory Analysis (GBTA) and its extension, Joint Trajectory Analysis (JTA). The first method uncovers the individual developmental trajectories of disorder and violence over time and the second method further examines the simultaneous relationship between two sets of trajectories. In the past, studies have shown

⁹ The problem of using macro-level geographic units is that the findings might not be generalizable to smaller geographic units. Additionally, Groff et al. (2008) have found that there is a significant amount of variability in crime at the micro level that is often not observed at the macro geographic level. Thus, macro-level analysis may mask the dynamic relationships between disorder and crime (Weisburd et al. 1992; Groff et al. 2008).

¹⁰ Other researchers have argued the importance to explore crime at even smaller geographic units (e.g., Sherman et al. (1989) used addresses, Taylor (1999) used block faces, and Eck and Weisburd (1995) studied places with a place manager). Understanding the disorder-crime relationship at smaller geographic units is important and should be explored in the future.

¹¹ The data obtained from the Seattle Police Department did not include any crime related information in these block groups. Specifically, any block groups associated with tract 263 and most block groups in tract 264 and 265 had no incidents reported over the study period. Consulting with the police department, it was found that the data from these sites were not included due to the cited reasons.

correlations between disorder and violence with cross-sectional data. With the available longitudinal data and advanced statistical methods, this study is able to demonstrate whether these associations remain over time. The Poisson distribution is a standard distribution used to estimate the frequency distribution of offending that would be expected given a certain unobserved offending rate (Lehoczy 1986; Maltz 1996; Osgood 2000). In this study, zero-inflated Poisson models were used to accommodate the over-dispersion observed in the data.

Group-Based Trajectory Analysis (GBTA)

GBTA was originally designed to illustrate the developmental patterns of individual criminal offending (Nagin 1999, 2005; Nagin and Land 1993). The primary assumption of GBTA is that patterns of observations of interest over time can be approximated with a set number of groups characterized by polynomial growth curves (Nagin et al. 2003; Nagin and Tremblay 1999). Specifically, it is designed to identify latent groups of individuals with similar developmental pathways (Bushway et al. 2001; Weisburd et al. 2004a; Nagin 2005). When modeling the developmental pathways, GBTA allows individuals to follow different trajectories based on observed values (Bushway et al. 2001). The fact that it can capture the developmental process in a dynamic way rather than the traditional static way makes GBTA quite attractive for researchers who are interested in understanding long-term trends.¹²

Equation 1 represents a basic version of GBTA that is a polynomial function which models dependent measures over time (Nagin et al. 2003).

$$y_{it}^j = \beta_0^j + \beta_1^j \text{time}_{it} + \beta_2^j \text{time}_{it}^2 + \varepsilon \quad (1)$$

where y_{it}^j is the level of the dependent variable for individual i at time t given the membership in group j . The shape of each group is determined by the parameters β_0^j , β_1^j , and β_2^j . It is also possible to set up a higher order function. In order to determine the optimal number of groups, a comparison of the Bayesian information criterion (BIC) is necessary.

$$\text{BIC} = \log(L) - 0.5 * \log(n) * (k). \quad (2)$$

Equation 2 represents the calculation of BIC, where “L” is the value of the model’s maximized likelihood estimates, “n” is the sample size, and “k” is the number of parameters estimated in the given model.

Generally speaking, when a model gets more complicated, the model fit will almost always get better. To balance between model fit and parsimony, the second part of Eq. 1 takes into account the potential loss of parsimony and penalizes the increase in the number of groups. Except for when the benefits gained from adding an additional group outweighs the loss of parsimony, there is no reason to go with a more complicated model over a simpler one (Nagin 2005). The actual decision-making process regarding the final number of groups is much more complicated. In addition to using BIC as a criterion, the researcher also needs to take into consideration the relevant theories, the posterior probabilities of group assignment, the odds of correct classification (OCC), the estimated group

¹² Some researchers argue the quality of data and the availability of time-span of data will seriously impact the conclusion (see Eggleston et al. 2003). Nagin (2004) believes that all statistical tools will experience the same problems if sufficient information is not provided. Furthermore, Bushway et al. (2009) found that both GBTA and growth curve modeling identify very similar average developmental patterns of individual criminality.

probabilities, the proportion of the sample in each group, and whether meaningful groups are revealed.

Overall, GBTA has been applied widely to different subjects related to individual behaviors. GBTA has been used extensively in the field of criminology to illustrate the developmental patterns of individual criminal offending (Nagin 1999, 2005; Nagin and Land 1993; Nagin and Tremblay 1999; Nagin et al. 2003). Weisburd et al. (2004a) have first provided an example showing that GBTA can be used in studying crime patterns of places (also see Griffiths and Chavez 2004), while others have applied the method to the study of terrorist attacks (LaFree et al. 2009).

Joint Trajectory Analysis (JTA)

An extension of GBTA-Joint Trajectory Analysis (JTA)-further advances GBTA by adding the ability to connect two phenomena simultaneously (see Nagin and Tremblay 2001). Specifically, it is purposely designed to account for the co-morbidity of two distinct but theoretically connected developmental courses. Nagin and Tremblay argue that some problem behaviors, such as conduct disorder and hyperactivity, can co-occur at the same time without being manifestations of the same propensity (Nagin and Tremblay 2001, p. 18). Therefore, JTA can be used to show how the two behavioral trends relate to each other and whether the presence of one increases the likelihoods of observing the other trait. Following the same logic, this study uses JTA to capture any simultaneous relationship between violence and disorder, and its corresponding strength, without making an assumption about the underlying mechanism linking the two phenomena.

Results

In this study, separate GBTA on violence, social disorder and physical disorder incidents were conducted for the 570 block groups included. The graphic presentations of separate trajectory analysis results are shown below. Results generally show distinct trajectory patterns in each set of analyses. Based on diagnostic criteria, all models perform satisfactorily (the fit diagnostic results are provided in [Appendix](#)).

Violent Crime Trend

In the analysis of violent crime incidents, the results reveal four different trajectories. A four-group model was chosen through consideration of BIC statistics, stability of group assignment, OCC, size and meaningfulness of groups (see Fig. 2). In general, the graph illustrates clear downward trends of all violence trajectories over the study period.

Consistent with the past literature, the results reveal a clear concentration pattern of violence (Sherman and Weisburd 1995). The High-Rate Declining Trajectory, with only 22 census block groups (less than 4% of total block groups) accounted for about 22.7% of the total violent crime incidents. In these violent crime “hot spots”, 1,697 violent crimes occurred in each of the block groups over the 16 years. On the contrary, the Negligible Trajectory, though it included almost half of the block groups, only had about 77 violent crimes per census block group over the study period. This number is 22 times less than the intensity seen in the “hot spots.”

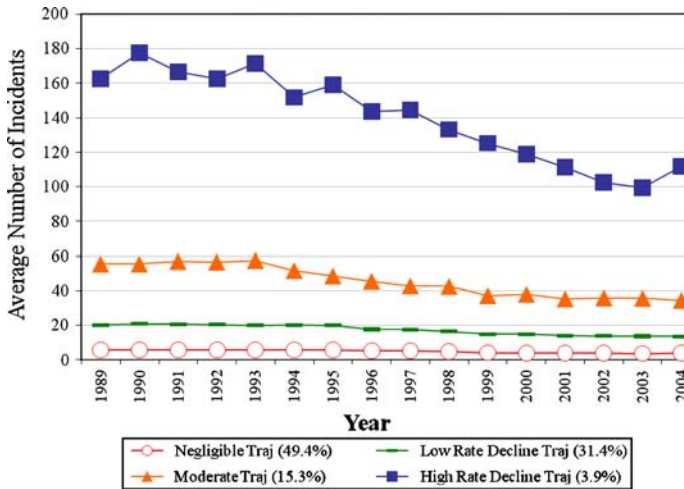


Fig. 2 Violence trajectories of census block groups in Seattle

Social Disorder Trend

The trends of social disorder were very stable over the study period. Using similar criteria, a three-group solution was chosen for social disorder (see Fig. 3). Unlike the violence trajectories, all three social disorder trajectories were highly stable except for the High-Rate Trajectory, which showed a little fluctuation in the initial 5 years (from 1989 to 1993) but leveled off afterwards. The results add to the hot spots literature by showing that social disorder, just like violence and crime in general, also concentrates at places. About 12% of the block groups were responsible for almost half of the social disorder incidents.

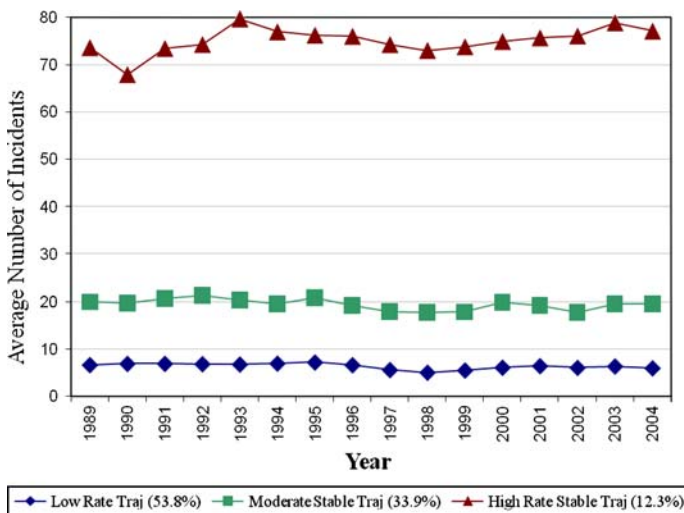


Fig. 3 Three trajectories of social disorder

The trajectory patterns of social disorder incidents are particularly interesting when considering what happened in crime trends around the same time period. A crime drop was observed over the past two decades in most places in the United States (Bratton 1998; Eck and Maguire 2000; Blumstein 2002; Blumstein and Wallman 2000; Kelling and Sousa 2001). This declining pattern was also seen in the overall crime trend in Seattle (see Fig. 1)¹³ and similar declining patterns were also found in the violence trajectory analysis presented above.

However, the findings from the social disorder analyses tell quite a different story. While social disorder and violence have been argued to relate to each other (both by the broken windows thesis and the collective efficacy perspective) in this data they do not appear to follow similar trends. Social disorder seems to be a stable phenomenon and the patterns did not follow the same declining patterns of the violence trajectories, even though they were drawn from the same data source. The implications of the differential developmental trends between violence and social disorder will be further explored using joint trajectory analysis described below.

Physical Disorder Trend

The trends of physical disorder are a lot more volatile than the previous two sets of trajectories. Four distinct trajectory groups were found for the physical disorder data (see Fig. 4). The physical disorder trajectories generally followed a classic boom-and-bust cycle. Again, the findings confirm the arguments of the hot spots literature that social illnesses, such as physical disorder, also cluster at a few places. Specifically, the High-Rate Trajectory represents less than 5% of the city (28 census block groups) but accounted for more than 22.8% of physical disorder incidents. The concentration of physical disorder “hot spots” is even greater than what was found in the analysis of social disorder, though not as salient as in the analysis of violence.

Joint Trajectory Analyses

A visual inspection of these three trajectory graphs side-by-side shows that the patterns do not resemble each other. The next logical question then is how the violence trends and disorder trajectories relate to each other at places. That is, are census block groups classified into the high disorder trajectory also characterized as having higher levels of violence? To answer these questions, joint trajectory analyses estimate pairs of trajectories simultaneously and show the likelihood of the co-occurrence of the variables of interest.

Violence vs. Social Disorder

We first analyzed the co-existing patterns between the violence and social disorder trajectories. The conditional probabilities estimated in the joint trajectory analyses represent the probabilities of belonging to any of the violence trajectory groups given membership in the counterpart social disorder trajectory group (see Table 2). For this set of analyses, the most interesting results would be those in the diagonals which show whether being classified as high in one phenomenon predisposes the block group to be in the high rate group

¹³ At a smaller geographic unit of analysis, Weisburd et al. (2004a) found similar declining crime trajectories in Seattle.

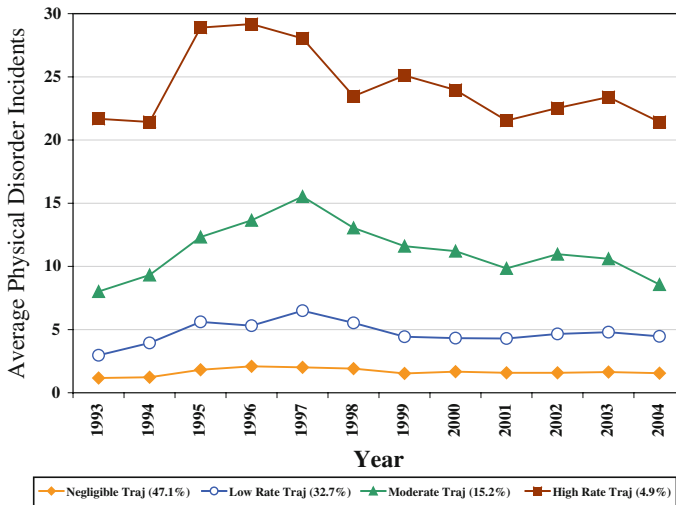


Fig. 4 Four Trajectories of physical disorder

Table 2 Conditional probabilities of the violent trajectory assignment given the social disorder trajectory assignment

Violence/disorder	Violence trajectory			
	Negligible	Low-rate decline	Moderate decline	High rate decline
Social disorder trajectory				
Low rate stable	0.881	0.119	0.00	0.00
Moderate stable	0.074	0.721	0.204	0.00
High rate stable	0.0	0.014	0.680	0.306

of the other phenomenon. Here the concordance rate between social disorder and violence is very high for the low rate groups.¹⁴ That is, when a block group is assigned to the Low-Rate social disorder trajectory, there is an 88.1% chance that this block group is also assigned to the Negligible violence trajectory, an 11.9% of chance of being classified as having low-rate violence, and no chance to be assigned to a Moderate or High-Rate violence trajectory group.

The same rule does not apply to the other social disorder trajectory groups. Places with a high social disorder problem only have about a 30% chance of also being in the High-Rate violence group, and have a 1.4% chance to be in the Low-Rate violence group and a 68% chance to be in the Moderate violence group. Although a 30% concordance rate between the high social disorder and the high violence groups is still very substantial, the consistency between the two is not as salient as in the low–low groups.

¹⁴ Two ordinal variables are concordant if one observation is ranked high on both variables or ranked low on both variables (Weisburd and Britt, 2007).

Table 3 Conditional probabilities of the violent trajectory assignment given the physical disorder trajectory assignment

Violence/disorder	Violence trajectory			
	Negligible	Low-rate decline	Moderate decline	High rate decline
Physical disorder trajectory				
Negligible	0.824	0.159	0.018	0.000
Low rate	0.285	0.527	0.171	0.016
Moderate	0.012	0.326	0.424	0.238
High rate	0.00	0.179	0.501	0.321

Violence vs. Physical Disorder

Similar patterns are observed in the physical disorder-violence comparisons (Table 3). The values in the diagonals are generally higher than the values in the off-diagonal cells. Eighty-two percent of block groups with negligible physical disorder problems are also relatively free of violence. But having been assigned to the High-Rate physical disorder trajectory group only corresponds to a 30% chance of having a high level of violence, while 18% of these block groups actually had a low level of violence problems. The results suggest that having few physical disorder problems almost guarantees a place to have no violent crime problems for places, while having severe physical disorder problems predicts having a violence problem about 30% of time.

In sum, both sets of comparisons show a somewhat similar story. Consistent with both the broken windows thesis and the collective efficacy perspective, places with no social or physical disorder tend not to have violence problems either. On the other hand, the presence of a high disorder problem is insufficient to predict the occurrence of a high violence problem at the same place.

Geographic Distributions of Trajectories

Geographic distributions of violence, social disorder and physical disorder trajectories are shown in the following maps in Fig. 5. The number of trajectory groups corresponds to their level of intensity. For example, trajectory 4 has the highest number of violent incidents (and is marked with the darkest color on the map) and trajectory 1 has the fewest (and is shown in the lightest color on the map).

Consistent with the arguments of traditional social disorganization theory, the “hot spots” of violent crime generally concentrate around the downtown area of Seattle, with some exceptions in the southern area (Fig. 5a). Social disorder and physical disorder also show similar patterns, with a lesser degree of concentration. The hot spots of physical disorder are located more toward the south than the violence and social disorder hot spots (Fig. 5c). Overall, the central and southern parts of Seattle generally have more disorder and violence problems than the northern areas.

When all three patterns were overlaid on the same map, the differential relationships between violence and social and physical disorder are much clearer. To make the illustration easier, trajectories of social disorder and physical disorder were dichotomized based on a principle that separated the highest level trajectory from the rest. Similarly, to better

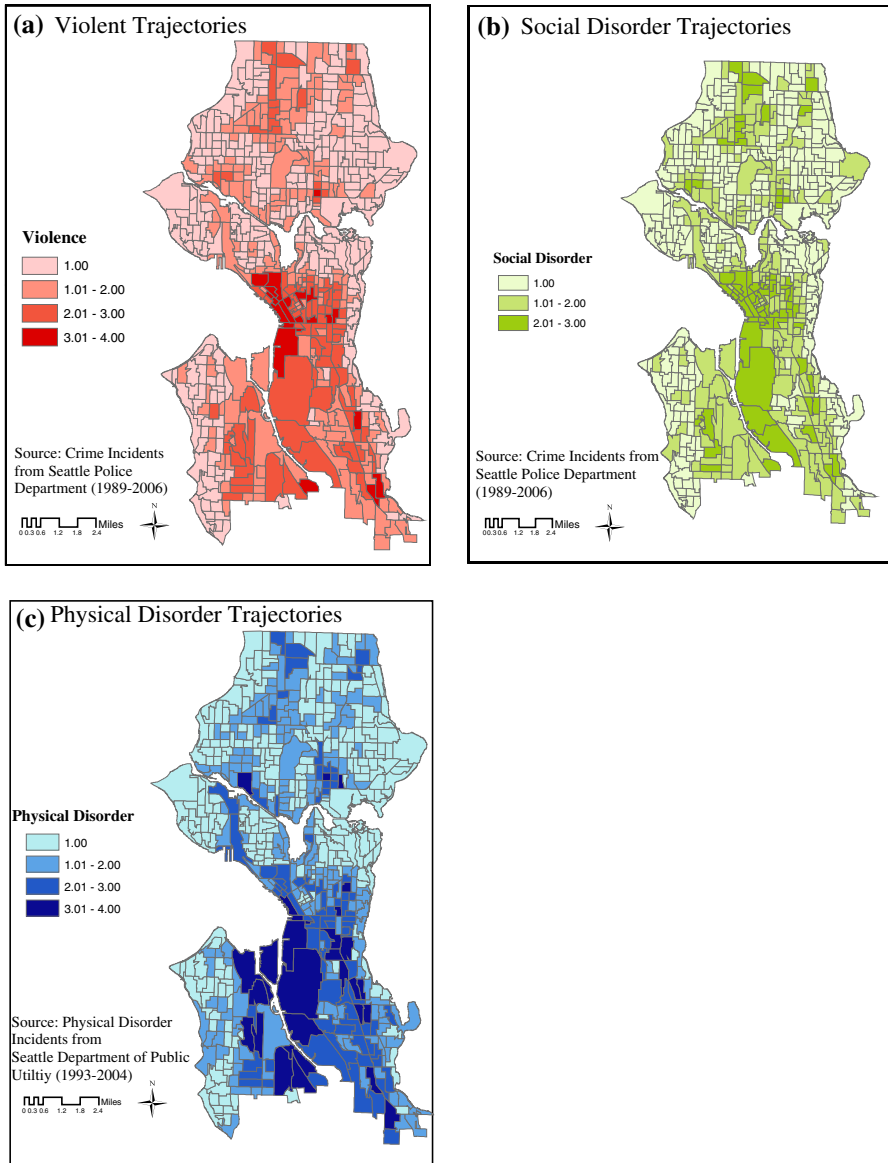


Fig. 5 Geographic distributions of different trajectory classifications

exemplify the distribution of violence with respect to disorder, only the highest and negligible violence trajectories were used in this analysis. Figure 6 displays the distribution of the four social-physical disorder combinations (high social disorder-high physical disorder, high social disorder-low physical disorder, low social disorder-high physical disorder, and low social disorder-low physical disorder) as well as the intensity of violence based on the dichotomies defined above.

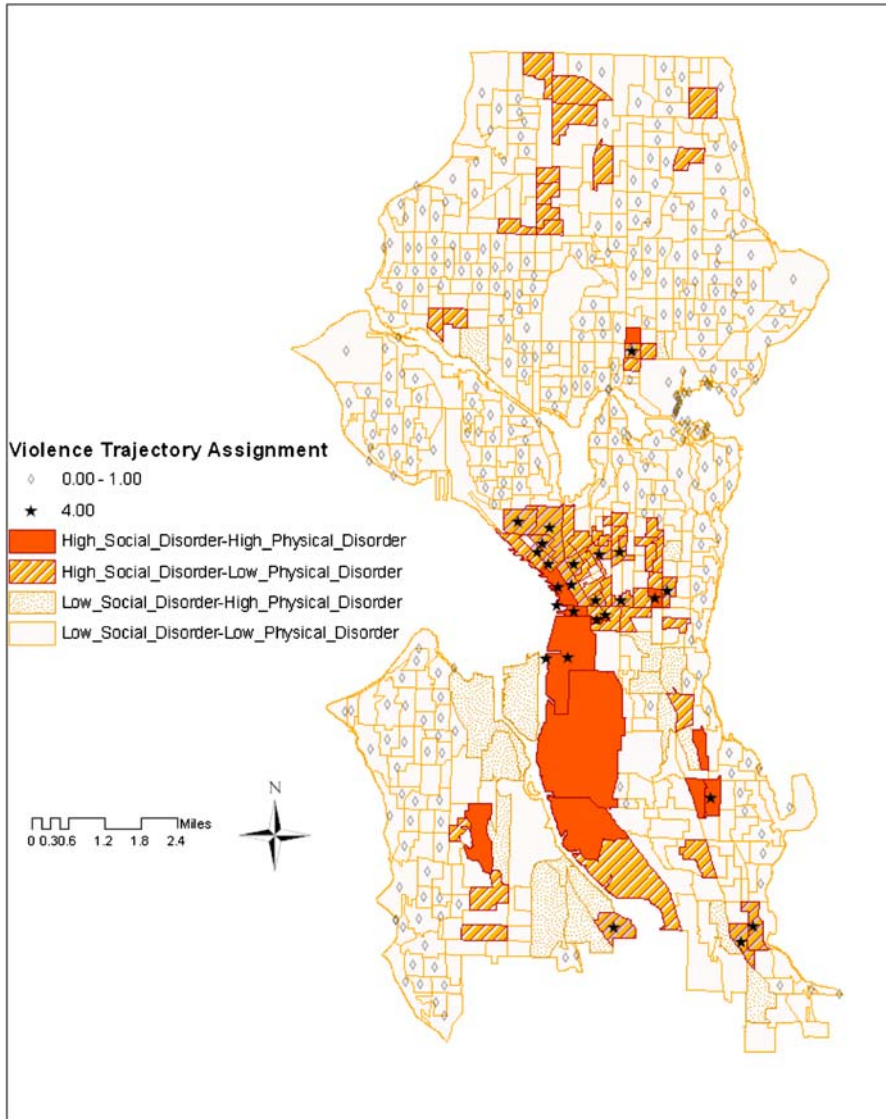


Fig. 6 Geographic correspondences between the distributions of violence and disorders

The patterns echo results from joint trajectory analysis while also highlighting other new findings. First, the low violence block groups (diamonds) *only* appear at places with low levels of both social and physical disorder. Thus the spatial distributions of the violence and disorder typologies once again confirm the findings shown in Tables 2 and 3 that places without disorder also do not have violence problems. Secondly, high violence block groups (stars) *always* appear on block groups with high levels of social disorder, regardless of the level of physical disorder. Thus, having high social disorder seems to be a necessary

condition for the occurrence of violence problems, but having high levels of physical disorder alone does not predict violence problems. Thirdly, while areas with high levels of violence always coincide with high social disorder, the majority of high social disorder block groups do not have high violence problems. That is, having high social disorder is not a sufficient condition predisposing a block group to be high in violence.

Discussion and Conclusion

As aforementioned, various theoretical perspectives all assume that disorder and crime are associated in urban environments over time. Until now, this link had not been examined thoroughly with longitudinal data collected at relatively small geographic units. This study serves as an important exploratory step to understanding the complex relationships between violence, social disorder and physical disorder in urban environments. The use of longitudinal data collected over a 16-year period and Joint Trajectory Analysis helps shed light on the role disorder plays in relation to violence in an urban city.

The results show that disorder and violence are indeed correlated at the census block group level as expected by different theories. This particular finding provides the empirical foundation for future research to further examine disorder and its linkage to crime. This study also provides a new advancement for disorder research by separately examining the two qualitatively distinctive types of disorder and their relationships to violence. The findings inform recent theorization efforts to consider disorder as a diverse concept, rather than a homogeneous one, in understanding the development of crime at places.

More specifically, four important findings emerged from this exploratory study. First, the findings show that disorder (both social and physical disorder), just like crime, concentrates at a small number of places. The “hot spots” or “the powerful few” are responsible for the majority of disorder problems in Seattle (see Sherman 1995, 2007; Sherman et al. 1989; Weisburd et al. 2004a). In other words, most places are symptom-free during the study period while only a few places exhibit a high intensity of disorder problems. This finding bears important policy implications for city administrators who wish to improve the outlook of their cities by directing resources at a limited number of places.

Secondly, the findings support both the broken windows thesis and collective efficacy theory in the sense that disorder and violence *are* correlated at places and this relationship is sustained over a long period of time. Thus, places with more disorder tend to also have more violence problems and vice versa. This relationship with respect to violence holds true for both social disorder and physical disorder.

Thirdly, the results also demonstrate an imperfect relationship between disorder and violence. While the absence of social disorder corresponds to not having violence problems at places, the mechanism does not always work the other way around. The presence of high social disorder problems predicts high violence problems only about 30% of the time. Thus, the existence of social disorder seems to be a necessary condition for places to have violence problems, but not a sufficient one to explain the presence of violence. This imperfect relationship was also revealed by the geographic examination (see Fig. 6) presented above.

This finding illustrates the importance of studying the disorder-crime relationship while considering other relevant contextual factors. If disorder and violence are analogous behaviors as suggested by the collective efficacy theorists, then perhaps the relationships between structural factors and the end products (crime and disorder) are not always constant. Sometimes they lead to both disorder and violence, and other times only to one but

not the other. It is important for future research to attempt to shed light on the circumstances in which disorder and violence are correlated in effort to explain this discrepancy. On the other hand, if disorder is the root cause of violence as suggested by the broken windows theorists, then perhaps some protective factors serve as buffers from the harmful impacts of unintended disorder. Future research which focuses on the broken windows ideas also needs to explore potential conditional factors mediating the effects of disorder on crime.

Fourth, there are differential relationships between social disorder and physical disorder with regard to violence. While both types of disorder are correlated to violence at places over time, social disorder shows a more consistent geographic relationship with violence than physical disorder. Physical disorder, unlike social disorder, does not seem to predict the locations of high violence areas. At best, the *lack* of physical disorder can be viewed as a protective factor for violence prevention (also see St. Jean 2007, for a similar finding).

Overall, the findings show that disorder (particularly social disorder) does predict violence—but only some of the time. As such it appears conditions of disorder versus no disorder at a place are not simply two sides of the same coin when it comes to predicting crime. In other words, places plagued by disorder are more likely to have a violence problem—but using disorder to predict violence at places would result in a high false positive rate.

It is also possible that the relationship between disorder and violence is not linear. For example, Taylor and Shumaker (1990) found such a non-linear relationship between disorder and fear of crime and suggested that in some highly disorderly places people become inoculated to disorder and are not bothered by it very much. They suggest that perhaps this is similar to people who live in places where earthquakes occur often being less fearful of them than those in places where earthquakes rarely occur. Perhaps the current results can be explained by the fact that violence only occurs in places where disorder has passed the “tipping point.” Future research should also focus on examining the possible existence of a threshold which must be surpassed in order for disorder to have impacts on crime.

The findings of this study have important implications for theorists who are interested in understanding the relationship between urban disorder and crime. Consistent with both the broken windows and collective efficacy perspectives, disorder and violence are longitudinally correlated with each very substantively. However, the far from perfect association cautions both perspectives to enhance their theorization to explain the discrepancy of places with high disorder having only a 30% chance of having violence problems.

Furthermore, the findings highlight the importance for future research to examine social disorder and physical disorder separately. The differential effects of social and physical disorder show the risk of using an overarching disorder label to represent heterogeneous behavioral patterns. Finally, future research should explore the impacts of disorder on other outcomes such as fear, satisfaction with quality of life, or property values. Even if disorder is not perfectly linked to crime, treating disorder might still bring other benefits for urban residents and visitors. Thus, the reduction of disorder can be desirable in its own sake, without being a tag-along for crime prevention purposes (Thacher 2004).

Limitations

There are several limitations of this study. One possible confounding factor for this association between disorder and violence trends is the shared data source. Both violence and social disorder incidents were drawn from the police incident database. As such, it is important to note that we cannot rule out the possibility that police enforcement targeting violence and social disorder may have biased the results and contributed to the high

correlations observed in the findings. Nonetheless, it is worth noting that St. Jean (2007) came to very similar conclusions regarding disorder and crime (i.e., robbery, batteries and narcotic violations) using a combination of cross-sectional data analysis and qualitative interviews in Chicago neighborhoods. Social disorder was also found to have a greater association with crime than physical disorder in that study. Thus the findings from St. Jean’s study suggest that the substantial association between social disorder and violence observed in this study is not simply a result of data confounding.

Another limitation stems from the uniqueness of Seattle and the generalizability of these findings to other cities. Relying on data from a specific region or city is not an ideal situation; however, it is not uncommon either in the field of sociology or criminology. The well-known Chicago school developed their theory based on observations from a single city (Shaw and McKay 1942). Sampson and Laub’s age-graded theory was solely built upon 1,000 male juveniles (500 delinquent juveniles and another 500 conventional counterparts) who lived in Boston during 1940s and 1950s (Sampson and Laub 1993; Laub and Sampson 2003). The similar findings from St. Jean’s qualitative study of Chicago neighborhoods lend some confidence of the generalizability of the current findings. Nonetheless, the uniqueness of Seattle reminds us that caution is needed when applying the results to other cities. It is also worth noting that while the results show that disorder concentrates at small geographic places like census block groups, future research needs to explore whether other unit of analysis, such as street segments, lead to similar findings.

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Appendix

See Table 4.

Table 4 Trajectory model diagnostics

Trajectory group	No. of block groups (% of total block groups)	No. of incidents (% of total incidents)	Average no. of violence	Average PP	Odds correct classification
Violence trajectories summary data and trajectory model diagnostics					
1	281 (49.4%)	21,759 (11.8%)	77.43	0.999	1,023.267
2	179 (31.4%)	49,662 (27.0%)	277.44	0.996	543.9936
3	87 (15.3%)	63,494 (34.5%)	729.82	0.999	5,530.412
4	22 (3.9%)	49,302 (26.8%)	2,241	1.000	+∞
Trajectory group	No. of block groups (% of total block groups)	No. of incidents (% of total incidents)	Average no. of social disorder	Average PP	Odds correct classification
Social disorder trajectories summary data and trajectory model diagnostics					
1	306 (53.8%)	31,273 (17.8%)	102.20	0.998	428.5093
2	193 (33.9%)	59,997 (34.2%)	310.87	0.997	648.001
3	70 (12.3%)	84,134 (48.0%)	1201.91	0.999	7,122.951

Table 4 continued

Trajectory group	No. of block groups (% of total block groups)	No. of incidents (% of total incidents)	Average no. of dumping	Average PP	Odds correct classification
Physical disorder trajectories summary data and trajectory model diagnostics					
1	266 (47.1%)	5,257 (14.7%)	19.76	0.986	79.1013
2	189 (32.7%)	10,734 (30.1%)	56.79	0.963	53.56633
3	86 (15.2%)	11,579 (32.4%)	134.64	0.994	924.2456
4	28 (4.9%)	8,138 (22.8%)	290.64	0.999	19,388.76

Note: Nagin (2005) suggests that when average posterior probability is higher than 0.7 and OCC values are higher than 5, the group assignment represents a high level of accuracy

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