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The Spatial Relationship between Drug Possession Arrests and Residential Burglaries in Austin, Texas

Ionara DeLima and Yongmei Lu

It is well recognized that the perpetrators of drug-related offenses and property crimes overlap. However, few studies have investigated the spatial relationship between these two types of offenses. Being one of the earliest efforts to bring a spatial view into the study of inter-crime relationship, this article examines the spatial proximity between the hot spots of drug possession arrests and residential burglaries in Austin, Texas. The study provides empirical evidence for the close spatial relationship between these two types of offenses. The findings confirm the theories of routine activity and distance decay to explain criminals' target hunting behavior. Moreover, the identified spatial patterns of these two types of offenses and their spatial relationships can support policing strategy and resource allocation for law enforcement agencies. *Key Words: drug possession arrests, residential burglary, crime hot spots, geographic information systems, exploratory spatial data analysis.*

The fact that many people who commit crimes are also drug offenders is well recognized. For instance, across thirty-five cities in 1998, between 40 and 80 percent of male arrestees in the Arrestee Drug Abuse Monitoring (ADAM) Program tested positive for drugs at arrest (ADAM 1999). Moreover, according to the Bureau of Justice Statistics, 27 percent of those serving sentences for robbery and 30 to 32 percent of those serving sentences for burglary in state and federal prisons said that they committed their offenses in order to buy drugs (Bureau of Justice Statistics 1991a, 1991b). As MacCoun, Kilmer, and Reuter (2003) pointed out, the past decade has seen the development of a solid scholarly consensus acknowledging that a raw correlation exists between drug and other criminal offenses (e.g., Fagan 1990; Parker and Auerhahn 1998; White and Gorman

Ionara DeLima is a doctoral student and Yongmei Lu is Assistant Professor in the Department of Geography, Texas State University, San Marcos, TX 78666. Email: yongmeilu@txstate.edu

2000). These findings support the claim that the occurrence of drug offenses might indicate the existence or emergence of other crimes.

Despite the existence of different explanations regarding how drugs and crime are connected (see Goode 1997), empirical studies investigate the relationship between these two types of illicit activities, either based on individual survey of inmates (e.g., Bennett 1998, 2000; Bennet et al. 2001) or through time series analyses (e.g., Corman and Mocan 2000). There is a general lack of investigation of the spatial relationship between drug offenses and other types of crimes. Existing studies failed to show how the spatial patterns of drug activities are related to the spatial patterns of other offenses. Now that "place" is becoming the central concern for current criminology (Eck and Weisburd 1995), it is important for crime studies to examine the spatial relationship between these two types of offenses.

Crime hot spots refer to areas of exceptionally high crime (Sherman 1995). Identifying hot spots is an effective way to reveal the spatial patterns of crime at a local scale. Technologies from geographic information systems (GIS) and exploratory spatial data analysis (ESDA) have been used to identify crime hot spots in general (Ratcliffe and McCullagh 1999; Craglia et al. 2000), and hot spots of residential burglaries (Groff and LaVigne 2001, Bennett and Durie 1999) and drug offenses (Taylor 2000) in particular. There is little research trying to link the spatial patterns of residential burglaries and drug offenses. We believe that such an effort should provide significant insight into the relationship between these two types of offenses. If residential burglaries and drug offenses tend to be spatially close to one another, further analysis to explain the underlying cause of the spatial association and to predict the patterns of one activity based on another can be greatly substantiated.

This study aims to advance our understanding of the relationship between property crime and drug activity through linkage of their spatial patterns. Residential burglaries and the arrests for drug possession in the City of Austin, Texas, are examined with GIS and ESDA techniques. The main research questions fall into three groups: (1) Are there hot spots of either residential burglaries or arrests for illegal drug possession in the study area? (2) Are the hot spots of residential

burglaries in close spatial proximity to the hot spots of drug possession arrests occurring on all types of properties? And, (3) are the hot spots of residential burglary in close spatial proximity to the hot spots of arrests for drug possession occurring only on residential premises?

Empirical Evidence of the Relationship between Drugs and Crime

Parallel to the theoretical uncertainty regarding how and why crime and drug use are connected (Goode 1997) is an abundance of research illustrating the close relationship between them. For example, Deadman and MacDonald (2002) examined occurrences in the United States and many countries in Europe; their study highlighted a strong association between illicit drug use and involvement in crime. French et al. (2000) conducted a study to estimate the relationships between chronic drug use and various measures of criminal activity. The following section summarizes the major contributions and limitations of related studies.

The Economic Aspect: Property Crimes and Drug Offenses

Among all types of criminal activities, property crimes are found to be more closely related to drug offenses than crimes against people. The latest sweep of a series of surveys in England found that 65 percent of the 1,435 arrestees tested were found positive for an illicit drug, and that property crime was one main source of illegal income for the drug-positive arrestees (Bennett 1998, 2000; Bennett et al. 2001). Several other studies also confirmed that the connection between drug offenses and property crimes is much stronger than that between drug offenses and violent crimes (Dobinson and Ward 1986; Anglin and Speckart, 1988, Harrison and Backenheimer, 1998). More specifically, studies show a consistent relationship between drug use and burglary (e.g., Cromwell et al. 1991; Bennett 1998, 2000; Corman and Mocan 2000; De Li et al. 2000; Bennett et al. 2001). Additionally, Switala's (2002) study suggests a consistent correlation between drug users and residential burglars.

One of the most familiar arguments in the literature for the relationship between drug offenses and property crimes is that illicit drug users are compelled

into property offenses to support their addictive habits (e.g., Gandossy et al. 1980). Inciardi (1979) and his colleagues interviewed 356 heroin users, and found that over 90 percent of them committed property crimes to support their drug habits. McGlothlin, Anglin, and Wilson (1978) found that during periods of drug addiction, individuals are more likely to commit crimes for illegal money and thus are more likely to be arrested during these periods. Benson and Rasmussen (1991) also conclude that property criminals and drug users are believed to be two groups largely composed of the same individuals.

A rise in property crime, therefore, might indicate a rising demand for drugs. When the demand for drugs increases, it is likely that other drug activities (including drug possession, drug delivery, and drug purchase) will become more frequent. Although the offenders of these types of drug offenses do not necessarily overlap with drug users, their offenses are related to drug use both spatially and temporally. Hence, the positive relationship between drug use and property crime might be extended to one between general drug activities and property crime. Research literature shows a close relationship between arrests for drug possession and property crime. When investigating whether communities with higher rates of juvenile arrests have higher rates of arrests for selling and possessing drugs, Linnever and Shoemaker (1995) found that property crime is positively associated with arrests for drug possession. Shepard and Blackley (2003) found that increases in arrest rates for the possession of non-marijuana drugs are associated with higher rates of robbery, burglary, and larceny. They found that, for the counties of 500,000 or more residents in New York State, a 10 percent increase in the mean arrest rates for the possession of drugs other than marijuana corresponds to an increase of robberies by 6 percent, burglaries by 15 percent, and larcenies by 78 percent. Considering that drug use is a relatively personal issue that has been reported with poor accuracy, revealing the relationship between property crime and drug activities such as illegal drug possession should provide crime analysts and law enforcement agencies with valuable information for the purpose of crime management.

The Spatial Aspect: From "Easy Target" to Spatial Proximity

Most of the existing analyses of the relationship between drugs and crime are conducted by focusing on the offenders. These studies investigate whether criminals commit crimes preceding or after drug use (e.g., Benson 1996; Makkai 1999; Corman and Mocan 2000). More specifically, this research does not tell us much regarding how distant (spatially) these two types of offenses are from one another, although they claim that they are "closely" related.

The only research to have touched on the spatial relationship between drugs and crime is that in the category of crime victimization studies (e.g., Goldstein et al. 1991; Inciardi et al. 1993; Maher and Curtis 1995). These studies explain the possibility of a potential target to be victimized as related to how far it is from an offender's area of drug-related activity. For example, Hough (1987) stated that potential offenders are attracted by easy targets; in areas where drugs are bought and sold and potentially used, individuals who frequent these places may be viewed as easy crime targets. Extending this conclusion to property crime, properties (e.g., houses, vehicles, and other personal belongings) within and close to areas of drug dealing and drug consumption tend to be viewed as easy targets by potential offenders. Hence, there might be a close spatial relationship between areas of intense drug-related activities and areas with elevated rates of property crime. It is the primary purpose of this study to reveal the spatial proximity between these two types of activities. We believe that by examining this spatial relationship, we can advance our understanding about the spatial patterns of drug possession and property crime. The results of this study can also provide law enforcement agencies and related policy makers with valuable information for their crime and drug control practices.

The Data: Drug Possession Data and the Patterns Of Drug Use

Drug use is not, and cannot be considered, the same as drug possession. However, they are closely related since an individual might illegally possess a drug for personal use or for selling it to potential drug users for economic gain. The close relationship between drug use and drug possession has been examined

through empirical studies. According to Rosenfeld and Decker (2000), the fact that drug arrests inevitably reflect enforcement activity does not invalidate them as a measure of underlying drug-using behavior. Through analysis of the validity of arrest statistics for measuring illicit drug use, they concluded that police arrest data can be used to measure the prevalence of drug use in urban populations. Similarly, when evaluating the effect of a "needle exchange program" in Baltimore, Marx et al. (2000) use the change of *drug possession* arrests rate as an effective indicator for the change of illegal drug use. They argue that if the program did indirectly result in more *drug use,* drug users would commit, and thus be arrested for, a relatively higher number of economically motivated *crimes, including drug possession* aiming at selling drugs for profit.

Law enforcement agencies expend considerable amounts of their resources on drug possession problems aimed at reducing and/or preventing illegal drug use. Correspondingly, drug possession data are widely available and commonly used. Specifically, when drug use data are not available, it is a common practice to use drug arrest data such as drug possession arrests as an effective indicator (not surrogate) for drug-related activity patterns (including drug use patterns). As a matter of fact, drug arrests are the source of information used frequently by local policymakers to address the drug problem (Pennell and Evans 1993) and by researchers to formulate explanations of the relationship between drugs and crime (Blumstein 1995).

Following the same practice, this study uses the arrest data for drug possession in the study area to reflect drug use activity patterns. Put another way, not having accurate information about drug use, this study investigates the relationship between the patterns of drug possession arrests and residential burglaries. We believe that the patterns of drug possession arrests can effectively reflect the patterns of drug use. This assumes that arrests for drug possession change in the same direction as drug use. Existing findings of the relationship between drug use and property crime can provide solid support for further investigation of the relationship between arrests for drug *possession* and property crime. Indeed, research into the drug possession–property crime link might help to clarifying the relation-

ship between drug use and property crime.

Theoretical Support for the Spatial Proximity between Drug Activity and Property Crime

With the shift of focus from offender to offense (Sherman 1995), the spatial distribution of crime becomes a central concern for criminological research. There are two important theories that provide the foundation for explaining crime spatial patterns: *routine activity theory* and the *distance decay theory*. Routine activity theory (Cohen and Felson 1979) proposes that people's daily routine activities affect the distribution of crime opportunities and crime patterns. According to the theory, crimes, especially predatory crimes, occur in relation to the convergence in time and space of three crime elements: (a) the motivated offenders, (b) the suitable targets, and (c) the absence of capable guardians for those targets. Bennett (1991) explored the macro-structural tenets of routine activity theory and confirmed what was found by Cohen and Felson (1979)—the routine activity model is crime-specific and it explains property crime better than personal crime. The spatial aspect of the routine activity theory is closely related to the distance that a criminal might travel to commit a crime. First of all, the farther a criminal travels, the less familiar he or she is with the environment and the more difficult it is for the criminal to identify a good target and to evaluate the guardian level. Secondly, there is a distance limit to a criminal's daily routine activity. In other words, it is less possible for the three crime elements (an offender, a target, and the absence of capable guardianship) to converge at locations far away from a criminal's anchor points (e.g., residence, working place, and shopping or entertainment places). The farther a place is from a criminal's anchor point, the less likely it is that it will become an offense location.

Coincidently, the major argument of distance decay theory is that the possibility for an offender to commit a crime at a location decreases with the increase of the distance from the location to the offender's anchor location or "anchor point." According to Brantingham and Brantingham (1984: 237), "from a criminological perspective, if a person is searching for a target to rob, and several potential targets exist, all things being equal, the closest target will be chosen." Given the

effort required to utilize space, Cornish and Clarke (1986) also argue that all other things being equal (e.g., amount of gain, risk of apprehension), there is no reason to believe that a criminal would choose a more distant opportunity for crime over a nearer one. According to Brantingham and Brantingham (1993), crime targets are usually located near an anchor location of an individual's daily activity. There are numerous empirical studies confirming that short-distance trips dominate criminals' crime-related trips (e.g., Rossmo 2000; Lu 2003).

This concept can be applied to the spatial relationship between locations of arrests for drug possession and locations of residential burglary, assuming that these two types of offenses are related to one another. Proximity to an anchor location provides less risk and greater territorial familiarity for a potential offender. A drug user is more likely to obtain drugs through a stable channel and consume drugs at a familiar location. In other words, a location of frequent arrests for drug possession is more likely to be in close proximity to a drug offender's anchor location, and it is also likely to be an area with a high incidence of drug-related activities. If drug users are to commit property crimes (residential burglaries, for example) to support drug consumption, they are very likely to commit these crimes near this anchor location (drug possession location). Therefore, it is reasonable to expect a close spatial proximity between hot spots of arrests for drug possession and hot spots of residential burglaries. As reported in previous research, properties in or near areas of drug activities have a tendency to be viewed as convenient crime targets by potential offenders (e.g., Hough 1987; Maher and Curtis 1995).

On an aggregate level, there are several reasons to expect that the burglaries committed by drug users would show close spatial proximity to the locations of drug activities, including drug possession. First of all, the findings that support the idea that most drug users maintain drug consumption by committing property offenses (McGlothlin et al. 1978; Gandossy et al. 1980) and that these two subgroups of offenders (property offenders and drug users) are largely coincident (Benson and Rasmussen 1991) lead to the argument that locations of these two types of activities may show similar spatial patterns. Secondly, when drug users are burglars, the burglary locations are more likely to be around their anchor

locations, as are the drug activity locations that might be represented by the locations of arrests for drug possession. Lastly, consistent with distance decay theory, it is reasonable to expect that drug users may prefer to travel short distances from an anchor location (related to drug possession location) to commit burglary. Therefore, the location of burglary should be spatially close to the location of drug activity for individuals who conduct both offenses; on an aggregate level, areas showing high concentration of drug activities should show spatial proximity to areas of high concentration of burglaries. The remainder of this article is an empirical examination of the spatial relationship between the distribution of residential burglaries and drug possession arrests in Austin, Texas.

Data and Methodology

Two specific types of crime activities—drug possession and residential burglary—are investigated for the city of Austin, Texas. Because the actual drug possession data are not available, considering the argument from literature regarding the close relationship between drug arrest and drug activity, the data for drug possession arrests are used to estimate the patterns of illegal drug possession. Analyses in this study examine the spatial proximity between the areas of high concentration of drug possession arrests and those of residential burglaries. Investigations are conducted by fulfilling three tasks: identification of the hot spots of arrests for drug possession, identification of the hot spots of residential burglaries, and the assessment of the spatial relationship between the two. An evaluation of the spatial proximity between these two types of crime activities would complete the criminological evidence for the close relationship between drug activity and property crime (see, for example, McGlothlin et al. 1978; Gandossi et al. 1980).

The location data for both residential burglaries and drug possession arrests in the City of Austin in the year 2000 were obtained from the Austin Police Department. Datasets contain projected coordinates of the reported crime locations. While being aware of the potential problem regarding the accuracy of geocoding (e.g., Ratcliffe 2001b; Burra 2002; Murray and Grubesic 2002), we conducted re-

search on the quality of the geocoded data from Austin Police Department and concluded that the police data is appropriate for this study.[1]

The drug possession data include the following offenses: possession of drug paraphernalia, possession of marijuana, possession of controlled substances, and possession of dangerous drugs. The locations of drug possession arrests are grouped into residential premises and non-residential premises. Premises (or properties) classified as mobile home, residence, apartment, duplex, condominium, and yard/porch and housing/public rental are grouped as residential premises, while premises classified as hotel/motel, shopping malls, or night clubs were grouped as non-residential premises. By grouping the premises in this manner, two types of spatial relationships can be examined and compared: (1) the spatial relationship between residential burglaries and arrests for drug possession in residential areas, and (2) the spatial relationship between residential burglaries and arrests for drug possession on all types of premises. Hence, the final data contain three datasets: 3,710 incidences of residential burglary, 6,317 incidences of arrest for drug possession on all types of premises, and 879 incidences of residential drug possession arrest (drug possession on residential premises).

One major technical challenge for this study is the crime hot-spot analysis. As pointed out in literature (e.g., Bailey and Gatrell 1995), there are many different methods for spatial autocorrelation analysis in general and hot-spot identification in particular. It is beyond the scope of article to compare different techniques as conducted in literature (e.g., Gordon 1998; Murray 1999). Nevertheless, we are aware that, due to the nature of hierarchical approach (Bailey and Gatrell 1995; Murray and Grubesic 2002), hierarchical methods are limited for crime hot-spot analysis. Moreover, since the number of hot spots to be identified is usually not *a priori* for crime analysis but a piece of information generated through analysis, we do not feel comfortable with partitioning methods either. Hence, a more robust technique that evaluates the concentration of point events through comparison of observed events with expected events would be a better choice.

A software package named Spatial Temporal Analysis of Crime (STAC) was used for hot-spot analyses in this study. STAC was developed by the Illinois

Criminal Justice Information Authority (Block 1995). Based on a scan-type algorithm, STAC repeatedly lays a circle on a grid and counts the number of points within the circle. A "cluster" is identified by the occurrence of more than the expected number of points inside the circle; circles of overlapping clusters are combined to form large clusters until no more circles overlap. STAC identifies the major concentrations of points for a given distribution and represents each dense area by a best-fitting standard deviational ellipse. STAC clusters can be of different sizes, and the routine combines elements of partioning clustering (the search circles) with hierarchical clustering (the aggregating of smaller clusters into larger clusters) (Block and Block 2002). However, STAC shows hot spots based on the ranking of the absolute number of events in the search circles. Considering that the size of clusters might be different, one would expect large clusters to have more points than small ones. For this study, to consider both the number of crimes and the size of the circle, the observed crime density in STAC ellipses was compared with the density distribution of Monte Carlo simulations. Only those ellipses with crime densities significantly higher (at 95% confidence level) than the density under random distribution are finally claimed to be crime hot spots.

The size of search radius and the number of minimum points per cluster are the two key parameters for STAC analysis. The search radius and the minimum number of points are context-specific and may require some trial and error. According to Block and Block (2002), a good strategy is to initially use a larger radius and then re-analyze areas that are "hot" with a smaller radius since the search radius is relative to the size of the study area. Guidi and Townsley (1997) pointed out that the search radius most suitable for analysis will vary from city to city. For the city of Chicago, Block and Block (2002) found that a 750-meter or 0.4660-mile radius is appropriate. Because Austin (around 242 square miles) is much smaller than Chicago (320 square miles), a smaller radius would be more appropriate. We have conducted a series of trials with radius sizes varying between 0.5 and 0.3 miles. Considering the final number of hot spots identified and the size of each hot spot that is best for crime management (as well as for map display), we decided that 0.4 is the best radius.[2] Coincidently, 0.4 mile is the average size of the block groups for

the City of Austin. It is common practice to relate the size of crime hot spot to block-group size (e.g., Lu and Thill 2003). The minimum number of crimes per hot spot is defined by considering both the practice in empirical studies (e.g., Block and Block 2002) and the opinions of police officers. Also, several tests were conducted, and the relative size of hot spots as related to the study area was considered. For this study, we set 10 as the minimum number of crimes per hot spot. Furthermore, each of the hot spots identified by STAC was compared to the results of Monte Carlo simulation, and only the ones with density significantly higher (>95%) than the simulated density are finally reported as crime hot spots.

To measure the spatial proximity and to identify the possible spatial associations between hot spots of residential burglary and those of drug possession arrest, the mean centers of different types of clusters were generated. A distance matrix was further derived to measure the distance between each pair of the crime hot spots of different types. All results from the STAC routine were transferred to ArcGIS Desktop for mapping and visual interpretation of the hotspots.

Findings

Spatial Concentration of Drug-Possession and Residential-Burglary Arrests

The hot-spots analyses of arrests for drug possession in all types of premises and of residential burglaries are reported in Figure 1. When linking these two types of offenses, the patterns in Figure 1 indicate that they are closely related in space. A visual inspection reveals that these two types of activities are both focused in the eastern part of the city. There are obviously three pairs of overlapping clusters located to the east of Interstate Highway 35 (IH-35). The first pair is composed of drug possession hot spot IV and residential burglary hot spot 2. They are on the southeast side near Riverside Drive. Also, on the east side of downtown and near Airport Boulevard, there are clusters of residential burglary hot spot 4 and arrests for drug possession hot spot I in close proximity. The third pair of clusters is located on the northeast side near the junction of Anderson Lane and Highway 290. It includes residential burglary hot spot 3 and drug possession arrests hot spot III. The only pair of hot spots to the west of IH-35 is located between IH-35

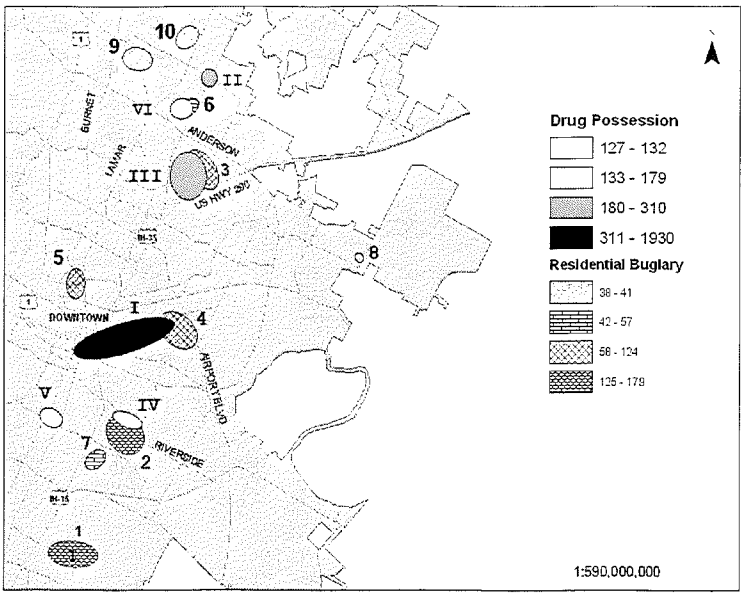

Figure 1. Hot spots of drug possession arrests in all premises (in Roman numerals) and residential burglaries (in Arabic numerals). The numbers in the legend indicate the number of offenses in each hot spot.

and Lamar Boulevard and consists of residential burglary hotspot 6 and drug possession arrest hot spot VI.

Figure 2 reports the hot spots of drug possession arrests on residential premises and of residential burglary. Since both analyses link drug possession arrests with the same set of residential burglaries, hot spots of residential burglary can be used as our location reference for discussion. The hot spot pattern in Figure 2 closely resembles the distribution of Figure 1. Figure 2 shows three pairs of overlapping clusters in the eastern part of the city of Austin—hot spots 2 and III, 4 and I, and 3 and IV. In the northern part of Austin, along IH-35, there is again an overlap of two hotspots (residential burglary hotspot 6 and drug possession arrest hot spot II). One interesting pattern that is worth noticing is the proximity of two

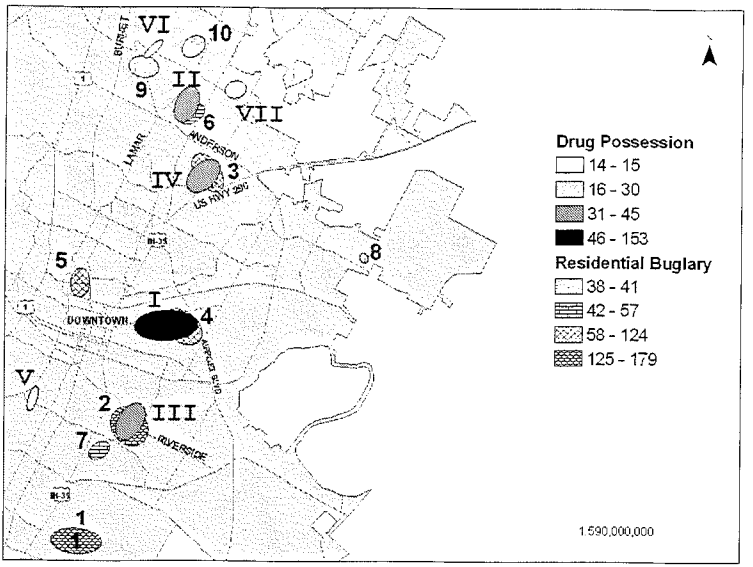

Figure2. Clusters of drug possession arrests in residential premises (in Roman numerals) and residential burglaries (in Arabic numerals).

residential burglary hot spots (9 and 10) in the northern part of the city. While they are not spatially related to drug possession arrest hot spots in Figure 1, a hot spot of drug possession arrests on residential premises emerges in Figure 2. This leads us to believe that if there is any connection between these two types of crimes in reality, residential burglaries in this area might be more likely connected to the possession of drugs in residences.

The same sets of residential burglary hot spots are consistently spatially related to hot spots of drug possession arrests in both analyses. This might indicate that there is a close relationship between the residential burglaries forming the residential burglary hot spots and drug activities represented by the arrest data for drug possession. In addition to the evidence provided in literature regarding how drug offenses and property crimes are linked along a time dimension (e.g., Makkai 1999; Corman and Mocan 2000) and through overlapping of offenders

(e.g., Switala 2002), patterns in these two figures support this close relationship between these two types of offenses from a spatial perspective. Therefore, although further quantitative analyses are necessary, a visual inspection of the patterns in Figure 1 and 2 undoubtedly confirms the hypothesis that the hot spots of arrests for drug possessions in the city of Austin are spatially close to the hot spots of residential burglaries.

Spatial Proximity between Hot Spots of Residential Burglaries and Hot Spots of Arrests for Drug Possession

To quantify the spatial relationship between the hot spots of residential burglaries and those of drug possession arrests, the geometric mean center is derived for each of the hot spots. The distance between the center of each residential burglary hot spot and every hot spot of drug possession arrest is further calculated. According to Ratcliffe (2001a), burglars might travel up to 3 km (around 1.9 miles) from their anchor location (e.g., home) to the location of crime. Other empirical studies also show that the majority of trips made by criminals related to offenses are shorter than 2 miles (see Rossmo 2000). For this study, a distance of 2 miles is used as a threshold distance to determine whether hot spots of the two types of offenses are potentially related to each other. This assumes that if a residential burglary is committed and is related to the burglar's drug offense, the drug offense location is likely to be an anchor location for the offender's activities. If, statistically speaking, property offenders travel up to 2 miles from an anchor location to commit burglary, then burglaries up to 2 miles away from a known drug possession location (a location of drug possession arrest) might be committed by drug offenders. Therefore, two hot spots of different types are considered to be spatially related if their mean centers are less than 2 miles apart.

The distance between every drug possession hot spot in all types of premises and every residential burglary hot spot is reported in Table 1. Distances of less than 2 miles are highlighted in the table. One can see that the closest hot-spot pair consists of drug possession hot spot VI (column) and residential burglary hot spot 6 (row), just 0.13 miles apart. The second closest hot-spot pair contains drug

possession hot spot IV and residential burglary 2 with a distance of 0.35 miles in between. The next pair on the list consists of drug possession hot spot III and residential burglary hot spot 3. They are 0.38 miles away from each other. Linking to the patterns in Figure 1, three out of four of the overlapping hot spots pairs have their mean centers less than half a mile apart. Out of six drug possession arrest hot spots, three of them are within 0.4 miles of a residential burglary hot spot, and all of them have at least one residential burglary hot spot within a 1.5 mile radius. These findings provide strong empirical evidence that drug possessions and residential burglaries are highly spatially correlated.

Table 2 presents a distance matrix for the spatial separation between the mean centers of the hot spots of residential drug possession and those of residential burglary. Several mean centers for one type of crime hot spots are spatially close to the mean centers of the other type of crime hot spots. For example, the mean center of residential burglary hot spot 2 and the mean center of residential drug possession hot spot III are just 0.12 miles apart. Similarly, there is only a distance of 0.13

	I	II	III	IV	V	VI
1	5.31	11.85	9.46	3.48	3.29	10.96
2	2.30	8.75	6.36	***0.35***	***1.90***	7.90
3	4.46	2.19	***0.38***	6.25	7.02	***1.55***
4	***1.36***	6.08	3.70	2.47	3.80	5.30
5	***1.77***	5.92	3.80	3.50	3.26	4.94
6	5.69	0.92	***1.61***	7.57	8.12	***0.13***
7	2.99	9.54	7.15	***1.24***	***1.50***	8.65
8	6.15	5.69	4.68	6.93	8.57	5.68
9	6.67	***1.84***	3.07	8.62	8.84	***1.62***
10	7.33	***1.11***	3.30	9.24	9.69	***1.70***

Table 1. Distance in miles from every hot spot of drug possession in all types of premises (columns) to every hot spot of residential burglary (rows).

miles between the mean centers of residential drug possession arrest hot spot IV and residential burglary hot spot 3. Other pairs of hot spots with mean centers no more than 0.5 miles apart include those for hot spots II and 6, I and 4, and VI and 9. Linking back to the patterns in Figure 2, four of the five pairs have their corresponding hot spots overlapping each other. The last pair, the residential drug possession arrest hot spot VI and the residential burglary hot spot 9 do not overlap but are still very close.

Table 2, like Table 1, reveals that 4 out of 7 drug possession arrest hot spots have a residential burglary hot spot no more than half a mile away. All but one drug possession hot spot are within a 2-mile radius of at least one residential burglary hot spot. A similar number of spatially associated hot-spot pairs (less than 2 miles apart) exist for both analyses. The analysis of residential burglary in relation to drug possession arrest in all premises had 13 short distances (less than 2 miles) out of 60 distances. The analysis of residential burglary in relation to drug possession arrests in residential premises had 14 short distances out of 70. This again

	I	II	III	IV	V	VI	VII
1	5.80	11.20	3.25	9.61	3.70	12.39	11.91
2	2.67	8.14	***0.12***	6.49	2.50	9.42	8.79
3	3.93	***1.79***	6.48	***0.13***	7.10	3.38	2.19
4	***0.42***	5.54	2.69	3.79	4.13	6.97	6.06
5	2.40	5.14	3.71	4.03	3.14	6.07	6.14
6	5.29	***0.29***	7.80	***1.56***	8.11	***1.91***	***1.24***
7	3.52	8.88	***1.05***	7.30	2.10	10.09	9.60
8	5.20	5.85	7.09	4.50	8.94	7.41	5.29
9	6.48	1.43	8.85	3.11	8.72	***0.50***	2.36
10	6.98	1.45	9.47	3.24	9.63	***1.00***	***1.51***

Table 2. Distance in miles from every residential drug possession hot spot (columns) to every residential burglary hot spot (rows).

indicates that residential burglaries are spatially associated with drug activities, no matter where the drug activities are. Since residential burglaries are more commonly and consistently reported (Craglia et al. 2000) than drug activities, the above conclusion can strongly support the use of spatial patterns of residential burglaries to help predict the possible patterns of drug activities.

Conclusions

This study helps to fill the knowledge gap concerning the spatial relationship between drug activities and residential burglaries. Based on the theories of routine activity and distance decay, the study concludes that the spatial proximity between hot spots of drug possession arrests and hot spots of residential burglaries indicates the existence of a close relationship between these two types of activities. It provides a strong empirical foundation for the theories trying to explain the relationship between drugs and crime in general (Goode 1997). Moreover, the empirical findings of the spatial proximity between drug possession arrests and residential burglary have significant implications for crime control policy and practice. By knowing the spatial relationship between these two types of activities, the deployment of manpower to fight against drug-related crimes can be more efficiently guided by the patterns of residential burglaries, or *vice versa*. A pattern change in one type of activity might indicate the development of a pattern change in another type of activity. Especially when burglaries are more often reported than drug possession, the patterns of residential burglary can be used as an important indicator for the patterns of drug possession.

The results of this study should not be understood as an illustration of causal relationship. There might be a number of reasons that residential burglaries and drug possessions are spatially related. First, some residential burglars might potentially be drug users and might be arrested for illegal drug possession. Given that an offender travels a limited distance from an anchor point for an offense, locations for both offenses should be spatially close to the anchor point, and thus, close to each other. Second, as previous researchers have found different types of offenses to be likely to occur in close proximity, areas of high drug activity might

actually attract other types of crime, such as residential burglaries.

Similar to most spatial statistics methods for cluster analysis, the STAC module is subject to modifiable areal unit problem (MAUP). STAC is used for this study because it effectively combines elements from hierarchical methods and partitioning methods for cluster analysis. It is commonly used and well recognized in the field of crime analysis. We acknowledge that the choice of search radius size and minimum number of crimes might impact the identified patterns of crime hot spots slightly, although a series of trials were conducted to pursue the most stable results possible. However, the focus of this study is to address the spatial relationship between drug possession and residential burglary. It is beyond the scope of this study to compare the sensitivity of different cluster analysis techniques to the potential problem of MAUP. Related analysis is left for further investigations.

In order to determine the exact level of spatial association between residential burglaries and drug possession, a more detailed study should be performed. One possible avenue of analysis would be to identify the proportion of convicted burglars that are also convicted for possession of drugs, and to further examine their drug possession locations and burglary target areas to confirm whether there is a solid correlation between these two types of locations. Still, the findings from this study set an initial foundation for future investigation. The results support a better-informed strategy for local policing and resource allocation for subsequent prevention and management of residential burglaries and the illegal possession of drugs.

Notes

[1]There are three reasons supporting this conclusion: (1) A subset of the data set was extracted for the authors to do independent geocoding; the result showed about the same accuracy as the data provided by the Austin Police Department; (2) The Austin Police Department conducted geocoding using a locally generated and high quality street file; and (3) The data was geocoded by experts with special training.

[2]Due to the length of this article, the results of running STAC for different

parameters (both the radius size and the minimum number of crime per hot spot) are not presented here. They are available from the author upon request.

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