Proceedings of the Ninth International Space Syntax Symposium
Edited by Y O Kim, H T Park and K W Seo, Seoul: Sejong University, 2013

DRUG CRIME AND THE URBAN MOSAIC:

The locational choices of drug crime in relation to high streets, bars, schools and hospitals

101

Lusine Tarkhanyan
Universtiy College London
e-mail : lusine.tarkhanyan.09@ucl.ac.uk

Abstract

This paper reports on initial findings from multidisciplinary research investigating the spatial and temporal distribution of illegal drug crime in one of the boroughs in London, United Kingdom. The physical location of more than 700 incidents of drug dealing were analysed at the street segment level using count regression models. The main focus was on testing the hypothesis that drug dealing is likely to happen close to facilities that inherently and routinely generate a large flow of people. To do this, the space syntax methodology of predicting movement flows in the urban environment was employed. The results showed that factors such as topological street accessibility and proximity to specific land uses have a significant effect on drug dealing locational choices.

Key words: *drug crime, street network, accessibility, land uses*

Theme: *Urban Space and Social, Economic and Cultural Phenomena*

1. INTRODUCTION: DRUG DEALING AND URBAN DYNAMICS

Crime is a spatial phenomenon. In environmental criminology it is widely established that the crime is closely related to the urban environment in which it happens. Moreover, the spatial distribution of crime incidents is not random: a large number of crimes are concentrated in a small number of places. For instance, in the study of drug crime (Sherman, Gartin and Buerger; 1989) 50 % of calls for police services are generated from 3 % of street segments. Another study (Weisburd et.al. 2004) showed that 5% of street segments accounted for 50 % of all criminal incidents over a 14-year period. In the study of burglaries at the street segment level (Johnson and Bowers; 2010) it was found that after considering the spatial distribution of targets the crime is more concentrated than expected.

Environmental criminology is interested in understanding why criminals commit crime at those places rather than somewhere else. Apart from socio-economic differences, scholars (Brantingham and Brantingham, 1982) suggested that an offenders target search process is based on the offender's perception of what constitutes 'a good or bad opportunity' to commit crime and it is also bounded by their 'awareness spaces' – the places that offenders frequently visit throughout the course of their daily routine. Thus, it is more likely that offenders commit crime near the 'routine activity nodes in their lives' than somewhere else in the city. These activity nodes are the places where both offenders and victims live, work, and go for shopping and recreational activities. Scholars proposed (*ibid*) that offenders search for opportunities and commit crime close to routes that connect these major activity places. Thus, the spread of urban features and the way they are connected in the city implicitly influence the spatial distribution of the crime.

This paper explores how the layout of the street network and the distribution of land uses might shape or support opportunities for drug crime. It addresses what is normally the lowest stage in the illegal drug supply chain – the street *drug dealing*. Here, the term refers to urban location(s) where illicit substances are illegally traded between anonymous participants. The study is interested in *where* dealers and drug buyers position themselves to engage in transactions at the street segment level. It examines the extent to which drug trading depends on the particular geography of urban fabric, and mainly the spread of bar, school and hospital land uses is examined in relation to drug crime. These three different land use types were selected on the basis of being an *activity node* that attracts a group of people who used its services routinely. The study is based on several assumptions. It is assumed that the spatial patterns of both buyers' and dealers' legitimate daily activities determine where the drug transactions occur. It is also expected that the drug trading location should permit equal access to both participants of the transaction (Eck, 1995).

The recorded crime data for two year time period was obtained from Metropolitan Police of London. The data includes more than 6,000 incidents of drug *production, supply* and *possession*. In this paper, only the physical locations of drug supply incidents were examined. The paper is organised as follows, first, the theoretical reasoning behind drug trading locational choices will be discussed. Next, the case study and crime data will be introduced, followed by a description of the main methodology and syntactical analysis of street network. The subsequent section will explore statistically the relational links between drug dealing locations, accessibility, high streets and the three different types of land uses. The paper will conclude with a discussion of the results.

2. MECHANISMS OF CRIME

An urban-dweller's routine consists of a number of activities distributed across the city and the practice of committing crime is no exception. According to Routine Activity Theory (RAT) (Cohen and Felson, 1979) in order for crime to happen three elements must be present at the location for the given time period: a motivated offender ready to commit a crime, the presence of an available or vulnerable victim(target) and the absence of a capable guardian who can prevent the crime incident. The capable guardian can be official (police, security personnel, place managers) or informal (people in the near vicinity of the target, neighbours, friends, parents). If at least one effective guardian is present at the location, the likelihood that the motivated criminal will attack the target is considerably reduced. In the case of drug crime, in order for the crime to occur, a motivated drug dealer has to come to the same place as an attractive target – a potential drug buyer. If a guardian is absent, corrupt, or present but not capable preventing the crime, the drug transaction is possible.

Additionally, scholars proposed that offenders do not navigate randomly across the urban environment (Cohen and Felson, 1979; Brantingham and Brantingham, 1984). The way in which offenders move around during their daily routine provides them with the knowledge about their surrounding environment and the opportunities it offers for criminal activity. Therefore, according to this perspective, crimes should be more highly concentrated within offenders' awareness spaces, where attractive targets or victims are present. The potential victim's routine is also not random. It involves moving around the urban environment within his daily routines and visiting places that lack effective guardianship. Thus, the crime opportunities have some spatial ordering that somewhat depends on the way people navigate across the street grid. This rationale has been applied by scholars to explain how both dealers and drug buyers identify places that are potentially suitable for transactions of the kind they involve themselves in (Eck, 1995, Rengert et al., 2005).

2.1 DRUG CRIME LOCATIONAL CHOICES

In legal trading, markets for goods which are highly valuable but purchased infrequently usually have a large market area, thus they are usually found in very accessible urban locations, which may attract many potential customers from remote locations. In contrast, local markets tend to supply items which consumers will wish to purchase frequently, but will be prepared to travel only short distances to get them. In the same way that legitimate businesses do not select their location at random, drug market placement may reflect rational decision making (Eck, 1995, Rengert et al., 2005): the main aim of both activities is to attract customers and supply products to them in order to make a profit. From a strategic perspective, when deciding where to locate their stores, retailers focus on finding an accessible spatial location which will attract many potential customers. Rengert et al. (1996) suggest that drug dealers may follow a similar logic and try to identify potential profitable sites. However, in contrast to legitimate trading, in the case of illegal markets offenders have an additional goal: staying safe and unnoticed so as to avoid arrest. Thus, drug dealing locational choices are also constrained by the presence of legitimate and capable guardians who discourage criminal opportunities (Eck, 1994).

Alongside spatial clustering, several scholars proposed that particular legal land uses have a criminogenic effect on drug trading locational choices (Eck 1995, Rengert et al., 2005). It has been noticed that the success of trading locations is associated with types of land-uses that are conducive to, or generate, other types of crime. For example, drug dealing is likely to happen close to facilities which inherently and routinely generate a large flow of people. These are mainly open public spaces, retail, entertainment facilities and transport interchanges that are associated with low levels of adequate guardianship or place management (Eck and Wartell, 1996). In their analysis, Rengert and colleagues defined two types of built environment facilities that may be associated with the locations of drug markets. First, there are those which indirectly increase the profits from drug sales, because they facilitate non-residents' access to an area. An example of this would be transport interchanges, which provide easy access to the drug markets (Brantingham and Brantingham, 1995). Second, there are those which generate opportunities for drug transactions because they are used routinely by potential drug buyers: for example, areas near to homeless shelters or pawn shops where potential buyers can readily convert stolen goods to cash (Anderson, 1999). The earlier studies established that drug markets tend to be located in close vicinity to certain facilities: shopping centres (Eck, 1995), high schools (Roncek and Lobosco, 1983), bars (Roncek and Lobosco, 1991), cash stores and pawnshops (Anderson, 1999), transport links, train stations and highways (Eck, 1994), and vacant homes (Rengert et al., 2005). Also, they found that there are facilities that discourage the establishment of drug markets in an area, such as police and fire stations or courts and federal buildings (Rengert and colleagues, 2005).

3. CURRENT STUDY AND PREDICTIONS

This study examined the physical locations of illicit drug dealing and whether their placement can be understood by studying the design of the urban environment in a novel way. Mainly, it focused on micro-spatial distribution of drug crime in the European type of street network, where the unit of analysis was segments with assigned crime incidents. With few exceptions (e.g. Friedrich et al, 2009), drug markets have not been examined at unplanned street layouts and at this level of analysis.

First, the study was interested in identifying common locational tendencies that explain the topological setup of drug dealing places in the urban environment. Mainly, how much of drug crime is accounted by the street network layout only. It is proposed that, all being equal, drug crime will tend to occur on more permeable street segments than somewhere else. Furthermore, the study tested how much of drug crime is accounted by the existence of high street or active centres of mixed land uses. Lastly, the study was interested in the relationship between specific land uses and drug crime. Based on this rationale, a series of regression models were performed, where the *dependent variable* was the crime count per street segment unit and *independent variables* were the degree of street accessibility for movement, high street locations and the walking distance from the three land use types.

3.1 THE CASE STUDY

As a case study, the Tower Hamlets borough was selected in the north east part of London, UK. The rationale for selecting this borough is that it has long history of illegal drug activity. According to the latest official statistics, the rate of drug crime in the borough is considerably higher (more than 4 times) than the London average (see Figure 1).

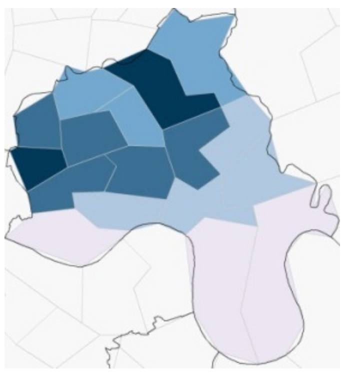
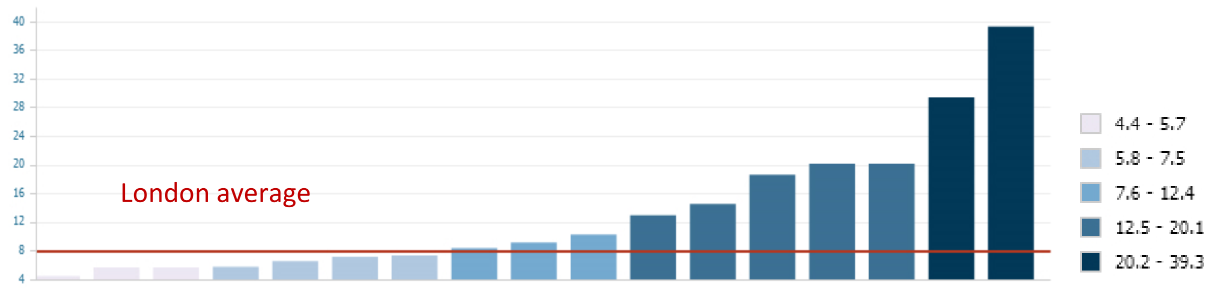


Figure 1: The map of the case study area with the rate of drug crime in comparison to London average score of 8.6 for the years of 2009/10. Rates are obtained from *quantile* distribution.



Source: www. London.gov .Ward profiles [accurate as at 29th January 2013]

The borough is irregular in its geography with an area of 7.6 square miles and the population of 226,500. This former dockland area has a very diverse urban context with a large variety of activities taking place across the urban fabric. It has twenty seven neighbourhoods including one of the financial districts of the capital – Canary Wharf located on the Isle of Dogs. Additionally, a considerable part of the East End of the capital is located in the borough and includes several diverse recreational districts with a large area associated with the night time economy.

3.2 DEPENDENT VARIABLE: POLICE RECORDED CRIME DATA

Overall 6,318 cases of drug crimes were obtained from the Metropolitan Police Service in 2011, for the two year time period from 1st April 2009 to 31st March 2011. The incidents were detected from normal police practice and a series of police operations. Each crime incident included information regarding the date of the arrest, information on drug types being possessed at the time of the arrest, location of the arrest with address information and postcode, and the number of people being suspected and accused. The entire dataset was divided into three discrete parts according to drug *production, supply* and *possession* classification. The definitions for these categories were adopted from Home Office's counting rules (2011). It was hypothesised that from a geographical perspective these three categories of drug activities will have different geographical distribution pattern. For example, dealers who supply drugs might be attracted to locations that have or are close to locations with a large number of potential customers moving on the streets. In contrast, the location of drug production cases might not be dependent on level of pedestrian permeability or geography per se. The crime records with full postcodes were geocoded. The Geo-conversion was done using the 'GeoConvert' online tool developed for UK academics that has a 0.1 meter address grid resolution. If it was impossible to retrieve the geographic location from the street address, the record was excluded from the dataset. After data inspection and cleaning only 6,605 records were accepted for further analysis. For this paper only drug supply (n=732) cases were analysed.

3.3 INDEPENDENT VARIABLES: ACCESSIBILITY LEVEL OF STREET SEGMENT

The total length of the street network in the case study area is 521km long comprised of 13,287 street segments, with a maximum length of 597 meters and an average segment length of 40 meters. In this paper the topological accessibility of street network for movement was calculated according to space syntax methods of configurational analysis (Hillier and Hanson, 1983). For every street segment in the network, the method defines the probabilistic level of street accessibility by computing the quantitative description of the street network based on the morphological and topological differences between locations. It sees the configuration alone as the primary generator of movement (Hillier et al. 1993, Penn et al. 1998). That is, the scholars argue that the morphology of the urban grid is organized in such a way that given a random distribution of movement flows across the street network, certain street segments benefit from a larger number of encounters making the area look busy, while other streets will have a relatively low number of encounters contributing to a higher degree of privacy. This unequal distribution of movement quantities is based on the strategic positioning of certain street segments over the other segments in the configuration. The method uses mathematical graph theory to capture these differences between many locations on the network.

The concept of *depth* or topological distance is used to measure the distance between pairs of nodes (street segments). Every trip through the network consists of the location where it originates, the destination where it ends and the series of accessible streets connecting the origin to the destination. It is statistically expected that the destinations that are closer to the origin will be preferred more often than the locations further away. Following this logic, the nodes that topologically have a central location in the graph will be used more as destinations than less accessible nodes. Moreover, based on patterns of connections in the graph, certain nodes are more central or are more important at certain scales than the others, thus the *destination preferences* can be identified for local to global scales of movement. This property of the graph is assessed using a *closeness* measure of network centrality referred by space syntax as *integration* or *movement to*. Hence, the nodes that are more integrated in the urban network will be used more as nearby destinations than the nodes that are less integrated or *segregated*. The space syntax analytical approach adds both the spatial precision and an ability to understand locations with common spatial charchteristics that aren't identifiable readily from visualising a map.

The *segment* map was obtained by converting a geographically referenced Integrated Transport Network (ITN) map of Tower Hamlets area with a buffer of 9km for reducing the edge effect. Using ArcGIS software the segment map was simplified, i.e. both the traffic islands and less than 1 meter segments were removed from the map. Using Depthmap software (Turner, 2001) *angular segment analysis* was performed for a series of metric radii, and the values of choice (*through movement*) and integration (*to movement*) were obtained for corresponding radii. The map in Figure 2 shows the degree of separation of a street section from all other sections at a set distance, taking account of angular deviation.

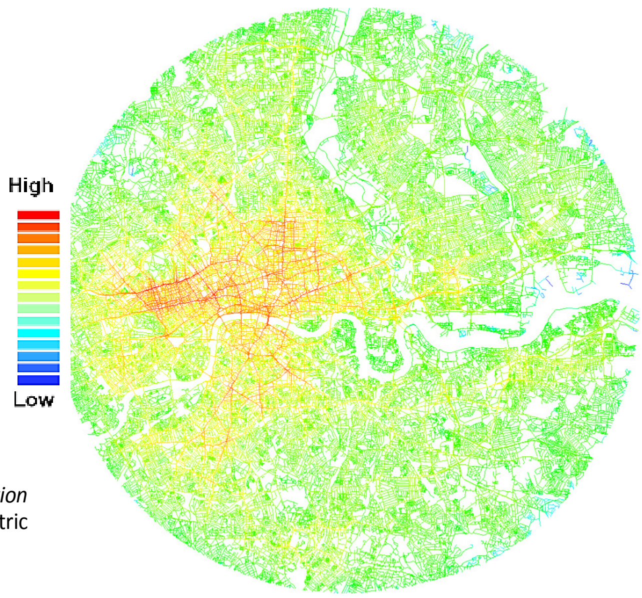


Figure 2: Segment angular analysis of *integration* or to-movement permeability for 2400 metric radius.Output from Depthmap software

3.4 INDEPENDENT VARIABLE: HIGH STREET DATA

High street was chosen as an independent variable, based on the rationale that it attracts a large flow of movement and that on intuitive notion everyone can distinguish between a high street and an ordinary street. Moreover, for the police it is easy to use a high street as a proxy- an anchoring point from which they can navigate into the adjacent residential neighbourhoods. It is hypothesised that since everyone can intuitively distinguish between a high street and an ordinary street, the drug dealer uses this spatial information to position himself in some relation to the high street.

A high street is a type of street very common in the UK. Usually, it is well positioned in the surrounding neighbourhood and is very permeable for local residences. The main characteristic of this type of street is in its great mix of different retail land uses located along the linear route of street segments and being well-connected with public transport.

This type of street attracts a large number of pedestrian movements in comparison to the rest of the neighbourhood. Often the same high street segment can be also an important traffic route. Although a recent report (Carmona et al.; 2010) showed that 6% of London street network is occupied by high streets, there is no official definition of a high street as a road typology in the Ordinance Survey. According to this classification some high streets are categorised under primary streets or 'A' type of streets or local streets. This study used a recent piece of research (Carmona et al.; 2010) on high streets of London as a guide to geographically locate the high streets in the case study area. The authors of the report state that they identified high street segments with 95% accuracy based on land use datasets and on field observations. The report made a distinction between high streets and agglomeration of streets consisting of mixed uses located near the city centre. This group of streets were defined as London's Central Activity Zones (CAZ). In this research both types of street segments - defined as high streets and counted as CAZ - were included in the analysis under *high street* category (see **Figure 3**). The reasoning behind this was that if drug dealers use 'active' street segments as a proxy for choosing drug dealing sites, for him/her both high street and CAZ type of street have similar operating conditions – a large flow of potential customers passing by.

In the regression model, each street segment was coded as a binary variable, whith '1' indicating that the segment is a part of a high street and '0' if the segment is somewhere else in the network.

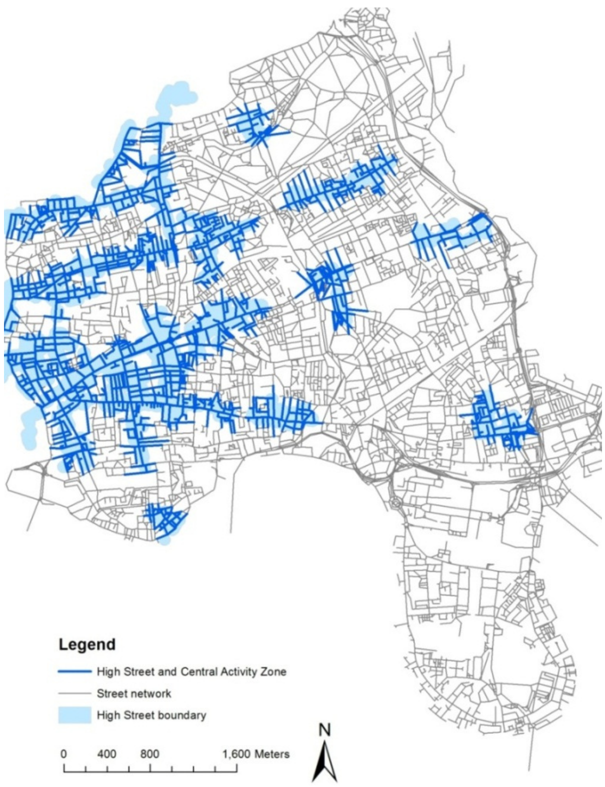


Figure 3: High streets map of the cast study area

Table 1 shows that 23% of the street network of the case study area is classified as high streets. On average the mean length of the high street segments is longer than the rest of the network.

Table 1: The fraction of *High Street* segments in comparison to the rest of the network with corresponding maximum and mean segment length in meters

Road type	Total length (km)	Fraction from the whole network (%)	Maximum segment length(m)	Mean segment length (m)
High street	120	23	294	43
None high street	401	77	597	39
All street network	521	100	597	40

3.5 INDEPENDENT VARIABLES: LAND USE DATA

In order to examine how people's daily activities associated with specific land uses can promote crime both at and around the locations, three different types of land uses - hospitals, bars and schools were selected. These three land use types were selected for acting as an activity node for groups of people who used its services routinely. For instance, the school is a central location where the young people comes together in their routine activities. Or the bar is a recreational facility where the chance of a motivated drug dealer encountering a potential client is high. It should be noted that, for instance, school-related incidences are not credited to the schools themselves; it is the routes *to* and *from* the school that are expected to be associated with crime. Therefore, in this research the street segments that are located in close proximity to these three land uses were identified and coded as places were the motivated dealer can encounter potential clients on the routes from or to the facility.

The geocoded land use data was obtained from the Ordinance Survey AddressBase product. Table 2 shows the count of land uses located near the high street in comparison to the rest of the network. It can be seen that 80% of the hospital buildings and 70% of bars are located near the high streets within a 100 meter buffer zone and some streets having 2 and 5 land uses per segment, correspondingly. In contrary, 70% of schools are located out of the high street buffer zone in adjacent neighbourhoods.

Table 2: Three land use count within a100m buffer zone from the High street and elsewhere

Land use type	Land use count *near high street* (maximum count per segment)	Land use count *elsewhere* (maximum count per segment)	Total count
Hospital	17(2)	4(1)	21
School	29(1)	63(1)	92
Bar	129(5)	58(1)	187

In this research, *street network buffer* was used to estimate the distance from land uses for every street segment in the case study area. That is the distance calculated using a metric layout of the street network. Since there are no guidelines on how to choose a buffer radius and there a need for a way to minimise an arbitrary buffer selection, this researcher has used *time* as a proxy for walkable distance. Thus, given the average pedestrian movement speed for the London area, 200m, 400m and 800m distance was chosen as a proxy for 2.5, 5 and 10 minute walks along the street network. Consequently for every land use type three different *distances* were calculated and binary coded. For instance, a segment was coded as '1' if it has at least one school within a 200 meter distance (approximately 2.5 minute walk along the street network) from a given segment, and '0' if no school land use was found within that distance (see Figure 4).

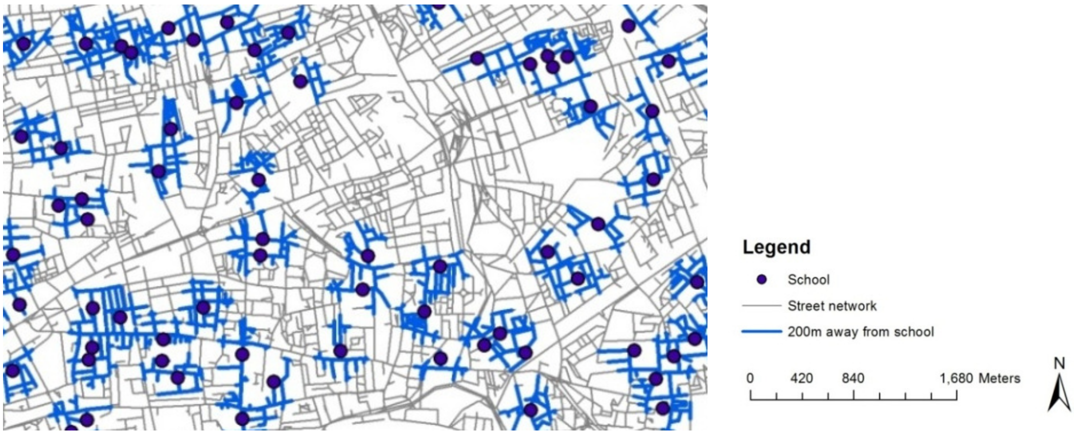


Figure 4: Map of 400 meter shortest network distance from schools

Finally, in conjunction with the police data, all these variables allowed the construction of a *crime incident based segment* model, where every given street segment had information on accessibility level, existence of a high street, land use type and whether or not a segment has drug dealing incident(s).

4. ANALYSIS AND RESULTS

First, the locations of drug incidents were examined in relation to high streets. Table 4 shows the drug crime count within a 100 m buffer zone from street segments. The crime count is relativized according to segment length, since longer segments have a higher likelihood of having more crime on them than the shorter ones. It can be seen that the drug dealing rate is higher near high streets than for the rest of the network. Also some segments have repeated incidents of drug dealing. The maximum repeated count for both high street and non-high street segments is 32 and 15 correspondingly. However, it should be noted that very few segments have multiple incidents of drug crime. **Figure 6** shows the frequency distribution of drug *supply* cases per segment unit of analysis. It can be seen that the distribution is skewed, where most of the street network segments have 0 crime incidents, most of the *crime prone* segments have 1 crime incident, and very few segments have more than 30 incidents of drug dealing.

Table 4: Drug crime within a 100m buffer zone from High street

Drug crime type	Crime count *near high street*(maximum count per segment)	Crime count *elsewhere* (maximum count per segment)	**Total length of** crime prone segments *near high street* (km)	**Total length of** crime prone segments *elsewhere* (km)	**Rate of** crime per km *near high street*	**Rate of** crime per km *elsewhere*
Supply	372(32)	360(15)	12.0	18.0	31.0	20.0

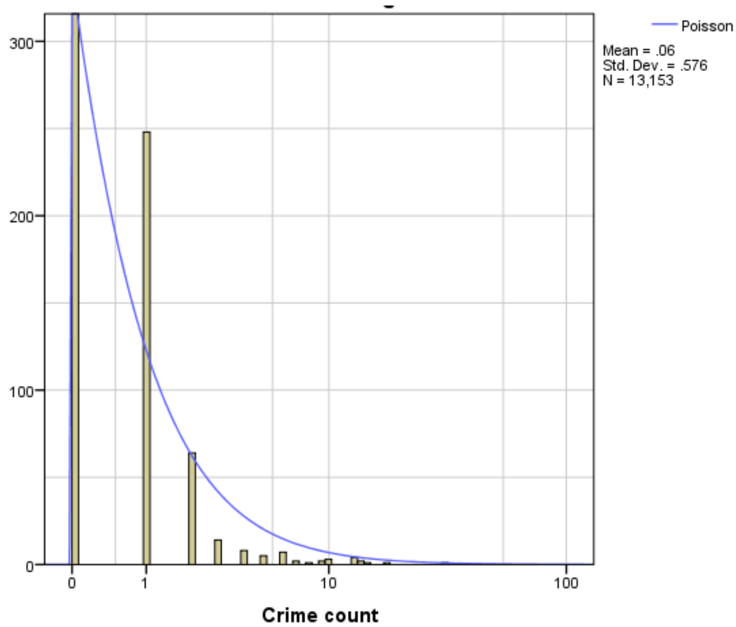


Figure 6: Frequency distribution of drug *supply* cases per segment unit of analysis, sample size n=13,153 segments, logarithmic scale with base of 10 (vertical scale was manually reduced in order to show small scale distribution of >0 crime counts)

Apart from skewed distribution, there was significant spatial autocorrelation in dependent variable (I=0.003, p<.001). In order to account for this a spatial Poisson regression model was used. The results are presented in Table 6.

Table 6: Summary statistics for 4 separate models of Poisson-Gamma regression, the dependent variable is *drug supply* incidents and unit of analysis is *street segment* (n=13,153 segments)

Summary of goodness of fit statistic	**Model**		
	1	**2**	**3**
Log likelihood	-2082.5	-2124.9	-2153.9
AIC	4175.0	4261.9	4321.7
BIC/SC	4212.4	4306.8	4374.1
Deviance	1924.5***	2122.0***	2222.1***
Pearson Chi-Square	57663.9	84397.0	99026.3
Model error estimates			
Mean absolute deviation	0.2	0.13	0.2
Mean squared predicted error	23.0	2.66	32.5
Individual predictors	**Coefficients**		
Intercept	-6.16***	-5.87***	-6.49***
To-movement accessibility (800m)	0.60***	----	----
High Street	----	1.07***	----
10 min. walk from Hospital (800m)	----	----	0.75***
2.5 min. walk from School (200m)	----	----	0.56***
2.5 min. walk from Bar (200m)	----	----	1.03***
Segment length (m)	0.02***	0.02***	0.02***
Spatial autocorrelation	-0.01 n.s.	-0.01 n.s.	-0.01 n.s.

*** p<0.001

Table 6 presents four separate regression models where the relationship between drug crime and urban environment was analysed. The first model tested the drug dealing locations in relation to topological properties of the street network, that is how much variation in drug crime locational choices is associated with the street network itself. Here, the street segments that are important as a destination for local movement within an 800 meter radius were examined. It can be seen that the destination preferences at a small scale of movement are positively and significantly associated with drug dealing locational choices after accounting for the variations in the street segment length. Thus in the model for every permeable street in the area, there was a contribution of 0.6 drug crimes. Also, it can be seen that the spatial effect was filtered out from the model if autocorrelation was significant that will indicate that the model cannot explain the additional clustering of the dependent variable.

The second model looked at the drug dealing incidents and the presence or absence of high street segments across the street network. It can be seen that for every street segment that is a part of the high street in the case study area there was a contribution of 1.07drug crimes, after accounting for the variation in the segment length.

The third model looked at the relationship between segments that have bars, schools and hospitals in near vicinity and drug dealing locations. Looking at individual coefficients, it can be seen that for every school and bar present within a 2 minute walk from a segment contributes to 0.56 and 1.03 drug dealing crimes, correspondingly. For every hospital land use present within 10 minutes walking distance, there was a positively contribution of 0.75 drug crimes. All relationships are significant.

It should be noted that the regression test does not output standardised *β* coefficients, thus it is not possible to make inferences regarding which independent variable has a stronger association with drug crime. In terms of the fit of the model, the N1 model shows better log likelihood followed by N2 and N3 models. However, smaller error estimates have model N2 followed by N1 and N3.

5. DISCUSSION & FUTURE RESEARCH

This paper was interested in examining how both the street network that shapes people's movement and the daily activities that are associated with specific venues can promote crime both at and around those locations. The study unfolded the geographical pattern of drug crime in the European type of unplanned street network. Also, the study used the physical geometry of street segments as a unit for analysing drug crime. This unit is more precise in modelling and predicting crime occurrences, since it acknowledges the spatial organisation of the street network and urban fabric as a whole.

The results showed that the distribution of drug supply crime across the street network is not random: a small number of segments accounted for a large proportion of incidents. Moreover, some segments had repeated incidents of drug dealing indicating that potentially a drug market is established on those locations. When tested statistically, the crime prone street segments have a high accessibility level for the local scale of movement. Moreover, those street segments that benefited from a larger number of encounters and attracted a high concentration of legitimate non-residential activities, such as those found on high streets, were more associated with drug dealing. It can be proposed that, similar to retail, at a topological level the drug dealing sites are attracted to locations that have a constant flow of foot traffic.

In addition to permeable locations, in order to further increase the drug sales, the drug dealer is likely to choose locations that are close to certain facilities or urban activities that attract more potential customers. The results showed that the presence of criminogenic land uses is predictive of drug crime levels in the near vicinity. The results showed that not the facility itself, but the routes leading to/from the given venue are positively associated with drug crime. For the bars and schools it was the immediate vicinity and for the hospital it was the surrounding area. It should be noted that in the given case study, most of the bars and hospitals were located along or close to high streets. Thus, it can be proposed that not only the land uses themselves have a criminogenic effect on drug crime, but the positioning of these land uses in close proximity to the high street provided more opportunity for drug crime. In the case of schools, only 32% were located near the high streets. It was difficult to establish whether these 32% accounted for the significant relationship with drug crime, or other factors are at play, such as the spatial and social organisation of the neighbourhood where the remaining 68% of the schools were located.

Future research plans to examine the relative positioning of criminogenic land uses in relation to accessible locations such as high streets in comparison to the rest of the network, in order to test whether or not the relative position of the given facility on the street network provides more opportunities for drug dealing.

Overall, the results are in line with the concept (Eck, 1994, Rengert et al, 2005) that the choice of drug dealing location is the end result of a multistage decision process, where a dealer seeks and identifies within the general environment a suitable location that will maximise the utility of their activity, i.e. maximising the profit from drug sales. It can be added that such decision making may not be explicitly intentional (although it might), but at some level drug dealers read spatial information and make (bounded) rational choices as to where to offend. From the crime prevention perspective, apart from arresting drug dealers, one of the police's main goals in targeting drug markets is to understand how the operational structure of these markets can be disrupted. It can be proposed that the high street and the presence of specific land uses within a certain walking distance can act as a proxy for identifying drug dealing sites.

In summary, the previous studies of drug crime have examined the spatial distribution of events using classical Euclidean space as the metric of choice, without reference to the composition of the street network. In contrast, in this study the spatial organisation of the street network is explicitly examined to see if and how patterns of drug crime are associated with it. It was showed that the probability of drug crime occurring on a street segment is influenced by the relative positioning of that segment in the street network. Also, after accounting for the influence of the street network, it is shown that the risk of drug dealing is additionally affected by the presence of specific facilities in near vicinity.

ACKNOWLEDGMENT

The author would like to thank Metropolitan Police Service of London for providing the crime data and for their comments regarding the data structure and how it was recorded. Thank you to Joanna Rowelle and Adam Towle for kindly providing cartographic material of High Street locations in London. The author wants to thank her supervisors Professor Shane Johnson and Professor Laura Vaughan for stimulating discussions, insightful comments and great support. Also thank you for the valuable suggestions from anonymous reviewers.

REFERENCES

Brantingham, P.L., and P. J. Brantingham. 1993. “Environment, routine, and situation: Toward a pattern theory of crime.” In *Routine activity and rational choice* edited by Clarke R.V. and Felson M. 259–294. New Brunswick: Transaction Publishers.

Carmona, M., M. Davis, and Gort Scott. 2010. *High street London*. Report by Gort Scott and UCL, London.

Cohen, L.E., and M. Felson. 1979. "Social Change and Crime Rate Trends: A Routine Activity Approach." *American Sociological Review* 44:588- 605.

Eck, J. 1993. “A General Model of the Geography of Illicit Retail Market Places” In *Crime and place,* edited by J. Eck and D. Weisburd. Monsey, N.Y.: Criminal Justice Press.

Eck, J. 1994. "Drug Markets and Drug Places: A Case-Control Study of the Spatial Structure of Illicit Drug Dealing." PhD diss., University of Maryland, College Park.

Friedrich, E., B. Hillier, and Chiaradia. 2009. “Anti-social behaviour and urban configuration using space syntax to understand spatial patterns of socio-environmental disorder.” In *Proceedings 7th International Space Syntax Symposium, e*dited by D. Koch, L. Marcus, and J. Steen. Royal Institute of Technology (KTH), Stockholm, Sweden.

Johnson, S. D., and K. J. Bowers. 2010. “Permeability and Crime Risk: Are Cul-de-sacs Safer?” *Journal of Quantitative Criminology* 26: 113-138.

Hillier, B., and J. Hanson. 1984. *The Social Logic of Space*. Cambridge University Press, Cambridge.

Hillier, B., A. Penn, J. Hanson, T. Grajewski, and J. Xu. 1995. “Natural Movement or, configuration and attraction in urban pedestrian movement.” *Environment & Planning B: Planning & Design* 20(1):29-66.

Rengert, G., J. Ratcliffe, and S. Chakravorty. 2005. *Policing illegal drug markets: geographic approaches to crime reduction.* Monsey, New York: Criminal Justice Press.

Roncek, D., and A. LoBosco. 1983. “The effect of High Schools on Crime in Their Neighborhoods.” *Social Science Quarterly* 64: 598-613.

Roncek. D. and P. Maier. 1991. “Bars, blocks, and crime revisited: Linking the theory of routine activities to the empiricism of ‘hot spots’.” *Criminology* 29:725–754.

Sherman, L.W., P.R. Gartin, and M.E. Buerger. 1989. "Hot Spots of Predatory Crime: Routine Activities and the Criminology of Place." *Criminology* 27:27- 55.

Turner, A. 2001. “Depthmap: a program to perform visibility graph analysis.” In *Proceedings 3rd International Symposium on Space Syntax,* 31.1–31.9

Weisburd, D., and L. Green. 1994. "Defining the Street Level Drug Market." In *Drugs and Crime: Evaluating Public Policy Initiatives,* edited by Doris Layton MacKenzie and Craig Uchida. Newbury Park, CA: Sage.