THE STORY OF THE CRIME:
functional, temporal and spatial tendencies in street robbery

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Abstract
There has been growing interest in the relationship between the built environment and crime. Only recently studies have started to focus on particular crime types, and extract its built environment characteristics. Most of these studies focus on burglary as it is the type of crime with the best record of location, and very few of these studies employed a standardized evaluation of the spatial layout. In this paper, we focus on street robbery, one of the least studied crime types.

Using the extensive amount of data from a case study area in London we demonstrate the links between street robbery occurrences, temporal and spatial factors in an effort to draw a multi-faceted picture of street robbery and place-based factors. We demonstrate the methodologies and discussions that arose while bringing GIS and Space Syntax analyses together and relate crime data with topological layers, as well as variations of results in different scales of effects.

We show the tendencies and appearing links between the times and types of robbery methods and global spatial measures like choice, and local measures like the potential movement differences between the crime locations and their immediate surroundings. This multi-factor and multi-scale approach contributes to our ability constructing the missing details or ignored knowledge in the complicated story of crime and built environment research has built so far.

Introduction
The built environment based crime research until now has rarely focused on robbery. The reason for this could be the difficulty in knowing exactly where a robbery happened, or the precautions against robbery seemed less applicable than other crimes such as burglary and thus the research being perceived more worthwhile. However, street robbery is a daily fear in urban life and reducing the type of settings that is most likely to take place should be the aim for achieving urban environments that are used effectively, day and night, for a sustainable urban development.

Keywords:
Natural surveillance  
Street robbery  
Street crime  
Crimes against person  
Hotspot  
Temporal patterns

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However, there are few pitfalls that a researcher should handle in order to find out how different built environment aspects affect robbery in different ways. The first aspect of robbery (and of other crimes to be spatially analyzed) that we should keep on mind is that its spatial pattern can be assessed in several viewpoints: The scale in which we are seeing the physical environment in, the victimization risk, the differentiations in robbery types, the temporal differentiation in spatial distribution pattern, constitution, the functions (land use types) on streets that offence takes place on and also the inter-relations of these streets with their surrounding in the configurational setting. Each of these viewpoints will tell another story and we can not make comments about the whole pattern of street robbery without acknowledging boundaries for research.

We should note it from the beginning that this paper is not looking at the pattern of street robbery from the victim side, in terms of where a person would be “safer” in urban environment, but instead it is adopting the “offender side”, with “where offenders tend to find victims” in mind. What is aimed is to bring an understanding into where and how in a complicated setting of urban environment, several types and scales of factors come together, following the path laid by Routine Activities Theory (Cohen and Felson, 1979) and Rational Choice Theory (Cornish and Clarke, 1986), bringing methodologies together between GIS and space syntax.

We will first of all try to discuss the nature of robbery as it is, referring to both qualitative and quantitative efforts of explanations seen in literature on robbery and street crime. Secondly we will comment on commonly used representations of crime distributions on urban space and discuss their weaknesses, especially in the case of street crime, compared to a micro-scale and topological model like space syntax. In the third section we will start our case study on street robbery, approaching it in 4 sub sections: first the introduction about case study area and methods, the challenges we face in measuring robbery in space, overall distributions in space, the temporal variations together with different types of robbery, and lastly we will attract attention to the sub-level effects under the overall picture, looking at the factor of depth structure around key routes in the urban environment.

Background

Looking at the literature on built environment and crime, one finds it difficult to establish a common comparing ground for the literature accumulated so far, due to the differences in aims, methodologies, setting and conditions, scale and scope, and even differences in definitions of terms and notions. Before we start dissecting robbery spatially and temporally, we should firstly understand the nature of the crime we are focusing on, and briefly comment on how conventional spatial representations of crime locations are missing out on the exact pattern of street crime.

Nature of Robbery

The definition of street robbery targeted in the case study of this paper is: a robbery where the victim is a person or a group of people, the victim is aware of the event, and the location is the public open space, excluding buses and buildings, including Snatch theft as a separate class.

Street robbery is listed among violent crime types in BCS and this class of crime is causing more worry among people than the property crime types such as Burglary or Car crime. As Jane Jacobs (1961) puts it, the public spaces are the vital organs of the city and it is essential to make them safer to make a city safer. “When people say
that a city, or a part of it, is dangerous or is a jungle, what they mean primarily is that they do not feel safe on the sidewalks” (p39).

However, studies of spatial analysis focusing on Street Robbery are extremely rare. A very detailed one is Alford’s study (1996) of Deptford, in which she takes snatches and robbery alongside other types of personal crimes in public realm. Robbery itself is grouped into unarmed and armed robbery. She concludes by stating that there is a significant link btw pedestrian flow, time and street crime, areas with the lowest pedestrian levels often attracted the highest levels of violent crime, while controlled access led to dramatic fall in the rates. The safest building-street interaction configuration was where the access to the house fronts onto the busy street, so that the public space abuts the private space. The most dangerous case was found to be where a semi-public space that comes off a vehicular cul-de-sac.

The victimization risk factor in robbery is put forward by Alford and supported by Hillier in his paper summarizing the pitfalls in built environment-based crime research (Hillier, 2004). Hiller and Alford look at risk in the sense of how the configuration of movement in urban space can increase or decrease the potential danger of being a victim of robbery and they point out that it is necessary to normalize the simple distributions of robbery with the estimated or observed count of people using the space. Therefore, we can say that Hillier and Alford were looking at the “victim side” of crime – space relationship in particular.

Although not quantitative, other two important sources on robbery are Wright and Decker’s (1997) and Smith’s work (2003). Wright and Decker summarize the nature of street robbery by showing the responses from his interviews with convicted offenders. Smith’s study gathers crime reports from several police authorities in London and brings an insight on methodological attributes of street robbery. Together, their points can be summarized as:

- Offences are in areas known to the offender,
- The victim is aware of the offence, at the time of offence, thus he would have limited time to offend and get cover,
- No clear boundary for legitimate existence of the person in location (unlike property related offences),
- Can be in several forms with varying confrontation and violence levels,
- Both the offender and victim are mobile,
- Happens where people are, public transport nodes and routes, active uses that especially attract people in dark hours of the day

These factors altogether make robbery a very selective crime spatially, needing both easy unsuspected access to people and quick cover being a major challenge for any offender. This nature of the crime should be acknowledged before trying to understand it spatially.

**Picturing “Where” Crime Happens**

The answers to “where” question in crime, especially for street crime, are illustrated by using either areal distributions or grid based unit comparisons such as hotspots, aiming to represent “place”, or “space” in a comparable way. However, although these methods are useful for easily perceiving the general distribution, they do not allow us to make a quantifiable and objective differentiation between “place”, “location”, “space”, the differences between spatial characteristics are not observed. and the spatial variables can not be fed into analysis.
The areal representations, when used as large units, usually only show the socio-economic differences in relation to crime, such as the wards with lower income levels or the districts that have uses that particularly attract crime. When broken down, where the boundary between two areas fall makes dramatic difference in what is captured in one, which is called the Modifiable Area Unit Problem (MAUP) spatial analysis literature since the 1930’s.

The grid based approach, although can be in higher resolution to capture a pattern, each grid is either cut off in representing what it has inside only, or is used in a surfacing method using all its neighbors. This results in grid methods not capturing the continuity along the movement structure, which is especially important in the case of a crime type such as robbery, which is closely related to movement.

Case Study

The study area covered in this study is a London Borough, with a population over 260,000 according to the 2001 census. The borough covers an area of approximately 43 km squares, contains 21 wards, over 100,000 dwelling units, 21 Tube and 11 train stations and includes a movement network of approximately 536 km in total distance.

The advantages of using this particular area for the study are mainly its intact and statistically decent sized crime dataset and its diversity as an area. The Borough council held a well-maintained and explicative 5-year crime dataset at the start of the study, supported by detailed land use and property GIS datasets maintained by the Council. The area is highly diverse in ethnic, demographic, land use and economic composition. It is also diverse in terms of the types of centers it has, since it contains several town centers of different sizes, inner city type residential areas and also residential areas that show suburban properties.

Some Challenges

Despite the advantages of Space Syntax in capturing the differences in micro-scale structure, we are also faced with some challenges when comparing entities representing space in the axial or segment model, in terms of “amount” of robbery and measuring attributes of space.

The first challenge to discuss here is how to relate robbery points to an axial line or a segment. Relating the points to their “nearest” segment is not the solution, as points are located somewhere along, sometimes to the centre of a building, where a house number is given, which in some cases are nearest to a line other than the line the data locator intended to. Also, about 30 % of the robbery points are placed by the police by referring to a junction, not a particular street, which is again a detail that would be overlooked if one adopted the “nearest” algorithm. Although not an ideal solution, the method adopted in the study so far is relating the points to the line within set vicinity, by creating a buffer zone around each line and counting the points falling within. In order to decide the amount of distance to be used for the buffer, several distances were tested from 10 to 50m, and the best capturing rate of the two sides of a street was achieved by using 30m as buffer distance.

The second problem is the lack of a standard unit in the model. The granular units forming the Space Syntax Model, namely axial lines and their segments, are not uniform in size and thus using them to measure the amount of crime brings on a difficulty. When we talk about a line or segment being more prone to robbery, are we talking about the pure counts of Robbery along a segment? If so, what
happens with changing length of segments, and thus changing size of buffers? A similar discussion was made for burglary in Hillier and Sahbaz 2005, with the term “denominator problem”. For burglary, the number of residential units can be used as the number of available targets, and also the residential units themselves could be used as units to compare targeted and untargeted ones. For robbery, it was pointed out that one does not have the targeted and untargeted “people” on the street.

First of all let us see if the length difference in lines does change the amount of robbery, in terms of pure counts or in terms of density on the line.

On the whole set of axial lines within the case study area, we can make 5 selection groups of increasing length, and check how each group’s robbery counts and robbery densities change (see table 1).

<table>
<thead>
<tr>
<th>Segment length group (m)</th>
<th>Total robbery</th>
<th>Total segment count</th>
<th>Total line length</th>
<th>Avg Di (per segment)</th>
<th>Avg Dipm (per segment)</th>
</tr>
</thead>
<tbody>
<tr>
<td>50-55</td>
<td>231</td>
<td>192</td>
<td>10054.11</td>
<td>1.203</td>
<td>0.023</td>
</tr>
<tr>
<td>100-110</td>
<td>281</td>
<td>123</td>
<td>12616.43</td>
<td>2.285</td>
<td>0.022</td>
</tr>
<tr>
<td>200-220</td>
<td>586</td>
<td>181</td>
<td>38110.78</td>
<td>3.238</td>
<td>0.015</td>
</tr>
<tr>
<td>300-330</td>
<td>723</td>
<td>128</td>
<td>40471.92</td>
<td>5.648</td>
<td>0.018</td>
</tr>
<tr>
<td>400-450</td>
<td>799</td>
<td>116</td>
<td>49120.89</td>
<td>6.888</td>
<td>0.016</td>
</tr>
</tbody>
</table>

When we plot the average robbery count (average of robbery count calculated for each segment in group), we see that this count increases as the lines get longer (see Figure 1a). On the other hand, when we look at Robbery per meter, we see that this measure decreases as the lines get longer (Figure 1b). These two plots show a contradiction, but both are true. It looks like normalizing with length of lines, to get the density of robbery, is a kind of “overcorrection”. This problem is similar to The Modifiable Area Unit Problem.

**Table 1:**
Segment length groups and measure of robbery occurrence

**Figure 1:**
(a) Average number of robberies in length bands,
(b) Average robbery per meter of segments in length bands
On the other hand, one should not opt for getting rid of the length attribute of lines or segments, as it is the changing length of lines that enables us to see the relative differences in the configurational values. Length is related to the number of connections, thus to integration and depth measures. Therefore, what comes out of length could indeed be a genuine effect of spatial significance after all. In the next section, we will ignore this discussion about challenges and look at the overall distributions, hoping to explain this genuine effect of spatial priority to a degree.

**Overall Distributions in Space**

As mentioned in previously, robbery is spatially highly selective, and is closely related to the existence of people, including offenders and victims, in the system. When we perform a quick multivariate regression on the whole system and look at several commonly used Space syntax measures as well as some land use types, we see significance on factors that point out centrality. Table 2a shows the results of 3 independent variables vs. pure counts of robbery per axial line and Table 2b shows the result after we introduce the number Retail, service and catering uses. The R2 increases from 0.28 to 0.58.

### Table 2:

(2a) results of 3 independent variables vs. pure counts of robbery, (2b) results after we introduce the number Retail, service and catering uses

<table>
<thead>
<tr>
<th>ANOVA Table D1 vs.3 independents</th>
<th>Regression Summery D1 vs.3 independents</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DF</td>
</tr>
<tr>
<td>Regression</td>
<td>3</td>
</tr>
<tr>
<td>Residual</td>
<td>5480</td>
</tr>
<tr>
<td>Total</td>
<td>5483</td>
</tr>
</tbody>
</table>

| Intercept          | -10.291 | 1.058      | -10.291 | -9.724  | < .0001 |
| Integration_HH_R3  | 2.492    | 0.166      | .238    | 15.006  | < .0001 |
| Intensity          | 28.719   | 4.261      | .104    | 6.740   | < .0001 |
| Choice             | 2.620E-6 | 1.051E-7   | 3.29    | 26.832  | < .0001 |

<table>
<thead>
<tr>
<th>ANOVA Table D1_pm vs.3 independents</th>
<th>Regression Summery D1_pm vs.3 independents</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>DF</td>
</tr>
<tr>
<td>Regression</td>
<td>3</td>
</tr>
<tr>
<td>Residual</td>
<td>5480</td>
</tr>
<tr>
<td>Total</td>
<td>5483</td>
</tr>
</tbody>
</table>

| Intercept                  | -0.64 | 0.007     | -0.64 | -7.367  | < .0001 |
| Integration_HH_R3          | -0.01 | 0.001     | -0.02 | -1.093  | 0.274  |
| Intensity                  | 285   | 0.030     | 0.161 | 8.930   | < .0001 |
| Choice                     | 1.365E-9 | 7.331E-10 | 0.27 | 1.862   | 0.027 |

Looking within types of land use, the most effective ones coming forward in t-value and significance are retail (R), service (S), stations and bus stops (Table 3). The weakest ones seem to be uses that lie on separate sites and not on the natural routes of everyday movement, such as offices (CO), industry (I), storage (ST), and thus not attractors of people.

When we plot these factors visually on the map (Figure 2), we also see that the accumulation around central locations and key routes. However, we should keep in mind that these accumulations are for all times of the day. For both axial and segment Choice, global radii of choice seem to perform better than integration values when compared with robbery distributions. This is because the integration R3 measure is not as “edgy” as the Choice measure (does not fall as rapidly as Choice value as you move away from the key route), and robbery is similarly selective on key routes. This suggests that robbery is more strongly related to “betweenness” or “through movement”.

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**Table 3:**

Looking within types of land use, the most effective ones coming forward in t-value and significance are retail (R), service (S), stations and bus stops (Table 3). The weakest ones seem to be uses that lie on separate sites and not on the natural routes of everyday movement, such as offices (CO), industry (I), storage (ST), and thus not attractors of people.
It is normal for robust measures commonly used in space syntax analyses to point out routes where street crime accumulates, what is more, it could be argued that one should always keep in mind that any measure pointing out the accumulation robbery over the whole graph, especially in a setting that involves one or more central cores, is highly likely to be related to the centrality of the locations and beware of using such measures on the whole system for explaining advantageous or disadvantageous conditions, their purpose should be limited to “painting the general picture”. The necessity of comparing like with like in the micro scale urban environment was previously pointed out by Hillier (2004). The aim in micro-scale spatial analysis of crime should be, more importantly, finding out how we can improve the conditions given by configuration, within the boundaries of the overall effects. This means even if central locations are prone to more crime, and they always will be, as we will never see the solution of eliminating centers, as analysts we should be after finding out parameters to aid us in eliminating the secondary inducers of crime,

<table>
<thead>
<tr>
<th>Table 3:</th>
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</thead>
<tbody>
<tr>
<td>Significance of some types of land use (top)</td>
</tr>
<tr>
<td>Figure 2:</td>
</tr>
<tr>
<td>(a) Integration R3 (b) Retail, Service and Catering (c) Choice RN (d) Robbery Points (bottom)</td>
</tr>
</tbody>
</table>
make the centers safer for individuals and riskier for offenders to commit crimes.

**The Temporal Variations and Different Types of Robbery**

As mentioned in previously, street robbery does have a temporal aspect, as it relies on the movement of people within urban public space, which has a temporal aspect of its own. The free text information on the methodology of each robbery record between years 2001 and 2003 (501 crimes in total) were read in order to extract the method of Robbery. Based on this method information, the robberies were categorized under the following types adapted (with slight modifications) from previous studies done by Alford (1996) and Smith (2003):

- **Snatch**: Minimum confrontation, usually performed by grabbing one’s property in view and running away.
- **Threatening behavior**: Confrontation exists, although no violence is used or weapon shown, the victims feel they may be attacked and consent to giving property.
- **Attack**: With or without warning using physical power or blunt object (excluding the use of knives or guns).
- **Weapon shown**: The use of knives or guns to threaten the victim

The hours in the day are represented as time quarters each spanning 3 hours as shown in table 4.

<table>
<thead>
<tr>
<th>Hours 24</th>
<th>Day Quarter</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>5,6,7</td>
<td>1</td>
<td>Early Morning</td>
</tr>
<tr>
<td>8,9,10</td>
<td>2</td>
<td>Morning</td>
</tr>
<tr>
<td>11,12,13</td>
<td>3</td>
<td>Midday</td>
</tr>
<tr>
<td>14,15,16</td>
<td>4</td>
<td>Afternoon</td>
</tr>
<tr>
<td>17,18,19</td>
<td>5</td>
<td>Evening</td>
</tr>
<tr>
<td>20,21,22</td>
<td>6</td>
<td>Late Evening</td>
</tr>
<tr>
<td>23,24,1</td>
<td>7</td>
<td>Night</td>
</tr>
<tr>
<td>2,3,4</td>
<td>8</td>
<td>Late Night</td>
</tr>
</tbody>
</table>

Snatch robbery appears to have its peak in the evening, although its existence can be seen in the day time as well (figure 3-a). It rapidly drops down in the late hours. The robbery that involves physical form of violence also has its peak in the evening (figure 3-b), but lasting longer into the late hours. Robbery by threatening behavior on the other hand, has its peak in the afternoon time and rapidly dropping after this point (figure 3-c). This type is responsible for adding the second peak in the afternoon into the overall robbery time graph. This type of robbery could be happening mostly after school hours, committed by younger offenders.

For visualizing the distribution of these types in space, The robbery points belonging to each group were then divided into the part of the day that they were committed in, as first half of the day covering morning, afternoon and late afternoon (between 6 am and 18 pm) and second half of the day covering evening, night and late night (between 18pm and 6 am).

All robbery types show a noticeable temporal and spatial pattern (Figure 4). Generally, all robbery types show a contraction during night time into the central areas and main roads and dispersion around the main roads during day time. The snatch type appeared as the type most likely to follow main roads, especially in the second half of the day. The hourly distribution of snatch robbery showed that its occurrence dropped sharply after midnight. Robberies by threatening...
behavior, attack and weapon shown had a much less linear pattern, away from the main roads in the first half of the day while migrating to bolder locations in the second half of the day. Where weapon was shown (in 74% of these cases the weapon was a knife), the pattern shows clustering around particular locations rather than following a dominant route.

As snatch puts itself quite differently from other types of robbery both spatially and temporally, one other thing we can look at, on graphs, is to what degree snatch type accumulates the key routes across time. If we limit ourselves to the axial lines within top 3 bands of global choice, i.e. key routes, we may compare the percentage of snatch across time on these key routes versus snatches happening all over the case study area. This is, in a way, opening a window only to reveal key routes and see how the two groups of robberies accumulate on these routes across time. Figure 5a below shows the percentage change of snatch type robbery on the key routes among all snatch type robberies across the whole case study area. Figure 5b is showing the same for all other types of robbery. Note that percentages on the Y axis do not go below 50%, so the majority of robberies do congregate along key routes, however, this accumulation increases for snatch in the early hours and late hours. Other robbery types, including non-violent robbery, tend to accumulate the other way around, more on key routes in the busy times.
Figure 4:
Distribution of robbery types in day and evening/night time

Figure 5:
a) the percentage change of snatch type robbery on the key routes among all snatch type robberies across the whole case study area, (b) the percentage change of all robbery on the key routes among all robberies across the whole case study area.
Sub-level Effects under The Overall Picture

After having seen the robust attraction factors for robbery, we are still left wondering if we can find an underlying, low-level effect of spatial configuration on robbery. The main routes with attractive uses (for both victims and offenders) are needed and will always exist in the urban setting. They can not be regarded as disadvantageous settings, especially if we think about the safety in numbers argument that both Hillier and Alford pointed to in their papers. If the reason for looking into configurational effects in explaining robbery is to help towards the making of a better environment, one should look into the underlying factors, however weaker they may be compared to the centrality effect, and perhaps this way we can at least say something about how key routes may be designed in order to minimize the advantages for a potential offender.

We have seen in the overall patterns that the robberies in streets that do not form key routes in space are much more dispersed, they do not show a spatial preference, and their counts are not high enough to derive comparative explanations. Therefore let us limit ourselves to the buzzing environment of robbery, the key routes, and try to pinpoint something other than the robust nature of these routes.

We start by looking classifying the segments within the whole case study area into 10 equal count groups in order of global segment choice measure (Radius 2000 m), and taking the top 3 groups into our focus. These routes are comprised of segments that accommodate the retail, service and catering functions as well as the segments lying between these functions.

If we visually compare the robbery points distribution around these key routes (figure 6) with the distribution of local angular mean depth we obtain through the segment analysis output in Depthmap\(^1\) (figure 7), we recognize a weak relationship between the accumulation of robbery points and the broken up, tangled patches, with lots of turns within a short distance, just in the vicinity of these routes. Some of these patches point out to housing estates, standing out so differently from the traditional metric and angular proportions street pattern, and some of them are a result of normal street pattern being broken up by a network of paths and alleyways joining each other.
In this exercise, we aimed to extract the locations where two very different scales of movement collide: deep patches with many angular turns in short distances, which we assume are used by mostly people who are familiar with them, around the flow-carrying routes. Then we checked the density of robbery with the existence of these depth-zones around potential routes.

In order to test if this visual pattern exists in a quantifiable comparison, we need to first form some comparing units for ourselves in terms of robbery density. As discussed above, among the challenges of using space syntax for comparing robbery locations is to measure to what degree a segment is associated with robbery. We used robbery per meter in this exercise to have a more continuous numerical value to compare, and to measure the density of robbery along a segment. We used the banding technique on this robbery per meter measure, as its distribution is highly skewed towards the lower end, in order to have comparable chunks. To do this, we banded the key routes in our selection into 6 bands of robbery per meter, starting from segments with no robbery and gradually increasing in each band, while assuring that none of the bands count is too low. The first band, which represents the segments where there was no robbery points captured, had the highest count in each analysis selection and it was not possible to equalize its count with the rest of the bands’ counts. The resultant band segment counts can be seen in table 5. Despite the advantages for distribution, having only 6 bands meant that using strong techniques like regression models meaningless.

The second tool we need to devise is a method to capture the “vicinity” of key route segment, and be able to say something in summary about the segments surrounding this key segment. As a practical -but not topological- method, we created a short distance buffer in GIS. We selected the segments in the intersection of this

<table>
<thead>
<tr>
<th>Band</th>
<th>Rob pm</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.000</td>
<td>649</td>
</tr>
<tr>
<td>1</td>
<td>0.000 - 0.025</td>
<td>283</td>
</tr>
<tr>
<td>2</td>
<td>0.025 - 0.046</td>
<td>272</td>
</tr>
<tr>
<td>3</td>
<td>0.046 - 0.075</td>
<td>271</td>
</tr>
<tr>
<td>4</td>
<td>0.075 - 0.128</td>
<td>263</td>
</tr>
<tr>
<td>5</td>
<td>0.128 - 0.205</td>
<td>273</td>
</tr>
<tr>
<td>6</td>
<td>&gt;=0.205</td>
<td>282</td>
</tr>
</tbody>
</table>

Figure 7: Local Angular Mean Depth ("T1024_Mean_Depth_R300_metric" in Depthmap output)
buffer zone around the key segments, and summarized them as the average local depth value around each band of “robbery per meter” (banded as described above). The histogram below (figure 8) shows the increasing average radius 300m angular depth within 300m around the key route segments, as the Robbery per meter value increases.

The first band showing a different result can be linked to the fact that segments with no robberies may have a significant amount of depth in their immediate surrounding, but this fact alone is not enough to make a street attractive for robbery. However, where there “are” crimes (i.e. the potential for robbery is already there), shallow segments with high global angular depth surrounding them seem to have a denser occurrence of robbery. The same procedure of this analysis section is repeated for robbery simple count bands and the trend was suggestive again. We tried this exercise with local distances of 200m, 300m, 500m and 1000m, and the trend was most clear in 300m, gradually breaking down as we increased the radius towards 1000m.

The angular depth of vicinity seems to be a very local and low level effect around the key routes, and although derived from standard segment analysis output, is different from the standard measure values per segment, as it is a relationship between the segment itself and its vicinity. Although space syntax analyses are relational between entities, this relationship is distributed overall and can not be captured on the item in question per se. In this exercise GIS was used to capture the vicinity of the segment, but space syntax can be used, with adequate topological algorithm applied in Space Syntax software, to capture this vicinity and relate it to the segment itself.

**Conclusion**

In this paper we tried to tell the story of street robbery, both spatially and temporally, pointing to what level of effects one may be observing when handling spatial variables and units. We tried to differentiate between overall picture of robust factors and weaker local effects beyond the robust factors.

We pointed out that the physical environment of analysis is so tightly in relation with its relative importance and the “type of place”, one has to be careful about which type of environment one is bringing to light when handling even micro-scale configuration variables. It is essential to differentiate the factors related to the centrality of location from others, in order to add on the knowledge on crime and space.

In the last section where we suggested a low level secondary factor that could work within central locations. The local angular depth in the vicinity of key routes seemed to be inline with the density of robbery.

Remembering the preliminary section of the analysis, it also should be admitted that further research is needed to associate this depth

\[Figure 8: Distribution of the robbery per meter value\]
difference aspect into: the temporal patterns and sub-types of street robbery based on the violence and methodology used, the constitution factor, and the existence of footpaths as one of these sets of factors would have fundamental affect on others. In order to avoid the possible mistakes that using one methodology for measuring crime can bring into analyses; different analysis methodologies should be tested. It could also be found out if a similar underlying effect exists for the non-residential street segments, as well as analyzing the land use types, constitution and the victimization risk factors for the non-residential street segments for our future research.

References


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i. The Measure is called “T1024_Mean_Depth_R300_metric” in Depthmap output

ii. In addition, we should not forget that the sample size for this group is much bigger than the other bands