The Correlation between Motor Vehicle Crimes and Urban Configuration

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1. Introduction

A crime is a wrongdoing that warrants the punishment of the wrongdoer (Lamond 2007), and understanding factors that influence it can assist the relevant authorities in the fight against crime. Crimes are spatial in nature and may relate to the presence of environmental factors such as high walls and lighting, dependent on if these favour criminals (Price 2016). Environmental criminology, the study of criminal activity and victimization and how space influences crime (Chainey and Ratcliffe 2005), investigates these relationships.

While much of environmental criminology is theoretical, this study sought to determine whether a correlation exists between motor-vehicle (MV) crimes and urban configuration within the borough of Lambeth for the period 2008 to 2010. MV crimes include Theft/ Taking of Motor Vehicles (TOMV) and Theft From Motor Vehicles (TFMV) while urban configuration comprised of physical features (streetlights, bus stops, open spaces, alcohol establishments, buildings and roads).

2. Background

2.1 Theoretical Foundation

The Rational Choice Theory (RCT) highlights that offenders commit crime based on the level of risk, reward and potential consequences while the Routine Activity Theory (RAT) suggests that the pattern of movement and the presence of guardians, handlers and managers may influence crimes (Chainey and Ratcliffe, 2005; Paynich and Hill, 2010).

2.2 Physical Factors and Crime

According to Poyner (1993) and Pease (1999), streetlights can help to reduce crime, dependent on place and time, and if properly targeted. This was, however, contradicted by Atkins et al. (1991). Streetlights were also linked to MV crimes at bus stops with Yu (2009) suggesting that the presence of bus stops, in conjunction with other urban factors, generally increased MVcrime (Yu 2009), thus highlighting dependence.

Armitage et al. (2011) suggested that connectivity and through-movement contribute to higher crime levels. This is supplemented by the suggestion that road network complexity and traffic flow influence crimes (Beavon et al. 1994) since criminals will seek the least risky way of committing offences (Matsunaga et al. 2011). Road networks are also linked with alcohol establishments as bars

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influence crimes along road networks (Beavon et al. 1994).

Taller buildings in large housing projects experience higher crime rates than large buildings in small projects (LaRue 1974). Gifford (2007) further highlighted the possibility that high-rises will experience more crime (per capita) than comparable low-rises.

Theories suggest that greenspaces facilitates reduction in crime through community bonding and surveillance (Bogar and Beyer 2016; Wen et al. 2006) while others suggestincreased crime and violence (Brownlow 2006; Stodolska et al. 2009).

3. Data and Methodology

The availability of open data from the sources identified below simplified the data collection process. Each dataset was prepared by clipping to the study area and merging or joining data from multiple sources where required.

Table 1 Data

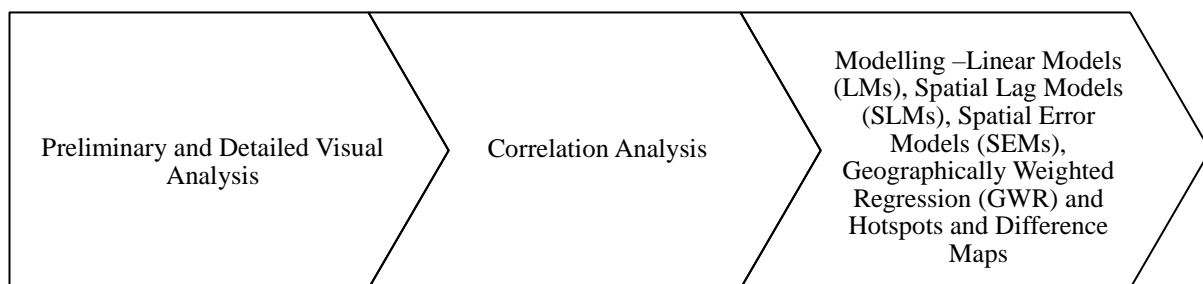| Data Source	Dataset
Edina Digimap	Buildings
	Roads
	Boroughs
	Wards
	London Output Area Classification (LOAC) Output Areas
	Water Courses
Greenspace Information for Greater London (GiGL)	Open Spaces
Lambeth Council	Alcohol Establishments
	Street Lights
London Datastore	Bus Stops
Ministry of Defence	MV Crime Events

Figure 1 Methodology - the approach taken to determine correlations.

Figure 1 shows the approach taken to determine whether any correlation exists.
- Preliminary visual analysis consisted of a basic analysis of each dataset, with focus on MV crimes and was used to observe general patterns. However, the detailed analysis gave a clearer understanding of the proximity of crimes to specific features.
- Correlation analysis was done in RStudio using the LOAC, ward and road output geographies. Pearson, Spearman and Kendall correlation methods were all done for comparisons but Spearman's rank was eventually chosen based on the monotonic nature and distribution of the dataset.
- Modelling was done to assess the influence of urban factors on MV crimes. LMs, SEMs, SLMs and GWR were done using urban factors selected based on data availability and their

influence of MV crimes. Hotspots and difference maps provided for visual and statistical assessments of the results obtained from modelling.

4. Results

4.1 Preliminary and Detailed Visual Analysis

Figure 2 Sample of map used for detailed visual analysis.

Preliminary and detailed visual analysis, done using maps (example Figure 2), highlighted that while MV crimes occurred across the study area, clustering was evident and TFMVs outnumbered TOMVs approximately two-to-one. Bars were located along mainly A and B roads and displayed clustering at junctions. Similar to bus stops, bars did not appear to directly influence MV crimes although a significant number of events occurred within 300m of these features. Local roads in residential communities experienced the most MV crime events, highlighting a relationship. No relationship between MV crimes and open spaces were noted and no real patterns were observed for streetlights.

4.2 Correlation Analysis

Table 2 Sample of Correlation results.

Spearman				
Factor	Crime	LOAC	Wards	Roads
Alcohol Establishment	All	0.22	0.24	0.15
	TOMV	0.15	-0.28	0.11
	TFMV	0.22	0.36	0.14

Though slightly varying, the results obtained for each correlation method using each output geography were generally insignificant or moderate at best. Due to the insignificant nature of the results, no solid conclusion could be drawn.
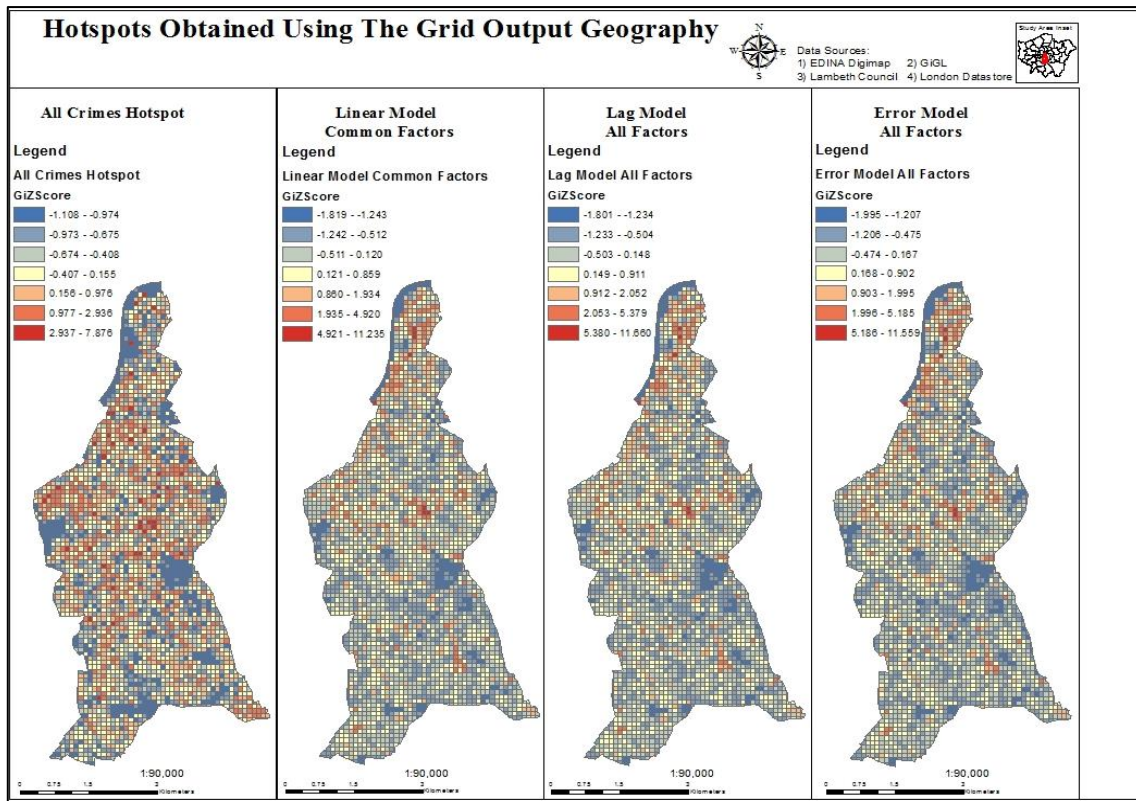
4.3 Modelling and Difference Maps

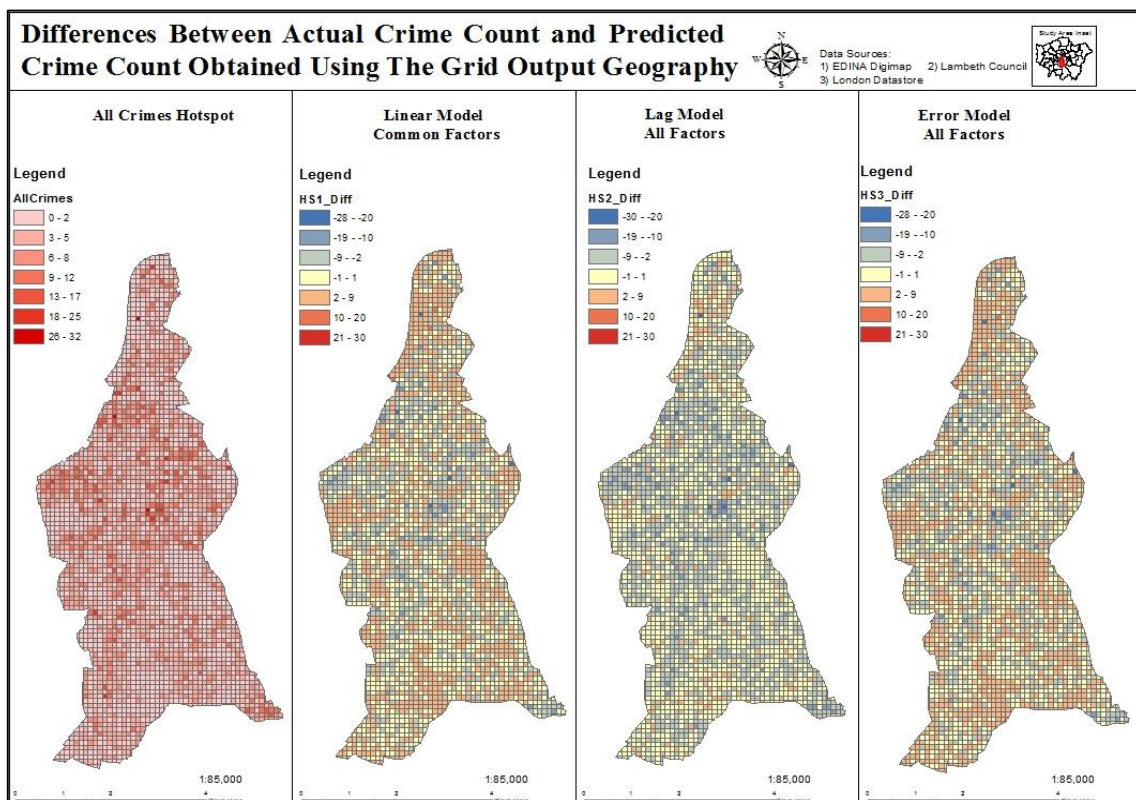**Figure 3** Sample of hotspot comparison maps.

Figure 4 Sample of difference maps.

LMs, SEMs and SLMs were done in RStudio and highlighted that each urban factor influenced MV crimes to different extents in each output geography. Bars consistently had a positive, moderate influence while streetlights varied. An assessment of all the results consistently showed small p-values and high significant levels for bars and streetlights. Lower and varying significance levels were obtained for bus stops while average building heights varied at the LOAC level.

When generated, the similarities in hotspots and minimum difference maps both indicated that the GWR provided the best results when compared to hotspots and maps generated using actual crime counts.

5. Discussion and Conclusion

A thorough assessment of crime and each urban factor was undertaken, highlighting a lack of research focusing specifically on MV crimes. Visual, spatial and statistical analyses were applied to the data to test associated theories.

Multiple output geographies were used for sensitivity testing of the methods, thus strengthening the analysis. Edge effects were considered by initially including a 1km buffer of the study area for the analysis, however, the lack of data beyond the study area skewed the results and analysis was restricted inside the boundaries.

The visual analysis provided a general understanding of spatial relationships but was not standardized while the correlation analysis alone was insufficient as it masked anomalies and provided mostly insignificant correlations. Further, the models did not indicate correlations but rather which factors contributed to MV crimes and to what extent. The LMs did not account for spatial relationships as the others. Evidently, the GWR which best accounted for spatial relationships provided the best results as seen in the similarities between the hotspot and difference maps.

Table 3 Concluding Summary.

Urban Factor	Author(s)	Theory	Findings
Streetlight	Pease (1999)	Improved lighting is associated with less crimes.	• Analyses failed to significantly support this theory. • MV crimes committed in areas well serviced by streetlights.
Bus stops	Yu (2009)	Bus stops, supported by other urban factors, attract crime.	• Theory supported by visual analysis. • Significant MV crimes occurred within 300m of bus stops. • Models suggested a small but notable relationship.
Open spaces	Bogar and Beyer (2016) (Brownlow 2006; Stodolska et al. 2009)	Open spaces facilitate reduction in crime. Open spaces increased crime and violence.	• Visual analysis and graphs showed more MV crime occurring away from open spaces.

Alcohol Establishments	Beavon et al. (1994), Yu (2009)	Bars were positively correlated with crimes.	• Analysis supported this theory. • MV crime occurred along minor roads within 300m of bars. • Modelling showed significant relationship.
Road Network	Bevon et al. (1994), Matsuanga et al. (2011), Armitage et al. (2011)	Possible link between regular, predictable road network and crimes.	• Theory supported by visual analysis. • These roads exist mainly in residential areas with roadside parking,thus providing easy targets.
Buildings	LaRue (1974), Gifford (2007)	MV crimes linked to high rise, densely populated buildings.	• MV crime linked to residential areas irrespective of height.

Though few solid conclusions can be made due to contradictions or a lack of strong support, the study successfully highlights the need for research into MV crimes, specifically its relationship with urban features, and provides a platform for such work.

6. Acknowledgements

7. Biography

Having studied on a scholarship, Roshan Seeramsingh recently attained a distinction in the MSc GIS programme at University College London. Having obtained a broader understanding of GIS, he intends to further his studies at the PhD level with focus on GIS for crime analysis.

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