Beyond the Hotspot: Exploring the impact of Land Use and Transportation Networks on the Spatial Crime Distribution

Kathryn Wuschke
Portland State University, wuschke@pdx.edu

Martin A. Andresen
Simon Fraser University

Allison Campbell
Simon Fraser University

Follow this and additional works at: https://pdxscholar.library.pdx.edu/ccj_fac

Part of the Criminology Commons

Let us know how access to this document benefits you.

Citation Details
Wuschke, K. Beyond the Hotspot: Exploring the impact of land use and transportation networks on the spatial crime distribution. Western Society of Criminology Annual Meeting, Vancouver, February 2016.

This Presentation is brought to you for free and open access. It has been accepted for inclusion in Criminology and Criminal Justice Faculty Publications and Presentations by an authorized administrator of PDXScholar. Please contact us if we can make this document more accessible: pdxscholar@pdx.edu.
Beyond the Hotspot:
Exploring the impact of Land Use and Transportation Networks on the Spatial Crime Distribution

Kathryn Wuschke, Martin A. Andresen and Allison Campbell
Urban Development and Crime:

• Context:
  – Crime is not randomly distributed
  – The spatial distribution of crime is impacted by the built environment
    • Land use
    • Road networks
  – Local relationships are important
The Local Context

• Measures the impact of built environmental features on crime patterns
  – Locally-based
  – Looking beyond the site of the feature itself

• Does crime also cluster around high-crime features?

• If so, how far?
What has been done?


• Song et al. (2016). Crime on the edges: Patterns of crime and land use change. *CaGIS*. 

Image: http://www.coquitlam.ca
Study Site & Data Sets

- Coquitlam and Port Coquitlam, BC

- Crime Data:
  - 2009 Crime Event Data for Coquitlam Detachment
  - \( n = 39,387 \) Records
  - Geocoded at 94% success rate
  - All points outside of Coquitlam and Port Coquitlam were excluded
  - All records relating to “founded” criminal code events were selected
  - Final dataset contains 12,786 records

Image: http://www.coquitlam.ca
Coquitlam and Port Coquitlam: Crime Event Density, 2009

Crime Event Density
- Low Density
- Medium-Low Density
- Medium Density
- Medium-High Density
- High Density

Local Municipalities
- Coquitlam
- Port Coquitlam
- Neighbouring Cities

Projection: NAD 1983 UTM Zone 10N
Sources: Event Data: RCMP E-Division, 2009
Boundaries: GIS Innovations, 2008; DMTI Spatial, 2006
K. Wuschke, 2016
Data Sets

• Land Use Data:
  – 2009 British Columbia Assessment Authority
  – Provided by Cities of Coquitlam and Port Coquitlam
  – Detailed data for every property in each city
  – n = 59,711 records, geocoded at 99% success
  – Data merged by address/land use
  – Final n = 37,039 including:
    • 1 Large Regional Shopping Centre and 7 Community-level Malls
    • 2 Hospitals
    • 65 Educational Institutions
Data Sets

• Road Network
  – GIS Innovations – 2008 data
  – 776 Kilometers of roads in Coquitlam & Port Coquitlam
    • 96 Kilometers of Arterial Roads; 99 Kilometers of Collectors
  • 60% of total road length classified as local roads
Coquitlam and Port Coquitlam: Land Use and Road Network, 2009

Land Use Category
- Residential
- Farm
- Commercial
- SOFA
- Industrial
- TCU
- CIR

Local Road Network
- Local Roads
- Major Roads
- Highways
- Freeways

Local Municipalities
- Coquitlam
- Port Coquitlam
- Neighbouring Cities

Projection: NAD 1983 UTM Zone 10N
Sources: Land Use: Cities of Coquitlam and Port Coquitlam, 2009
Boundaries and Roads: GIS Innovations, 2008; DMTI Spatial, 2006
K. Wuschke, 2016
Identifying Environmental Features

• Starting with the literature:
  – Crime patterns tend to concentrate around key features within the built environment:
    • Major Roadways
    • Major Nodes (Shopping Centres, Pubs, etc.)

• Looking Local:
  – Crime patterns vary from location to location
  – Important to identify which environmental features impact crime on a local level

Key reference: Kinney et al. (2009)
Image: http://www.coquitlam.ca
## Identifying Local Features

<table>
<thead>
<tr>
<th>Road Type</th>
<th>Road Length (KM)</th>
<th>% Total Road Length</th>
<th>Count of Crime Events</th>
<th>% of Crime Events</th>
<th>Events/KM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arterial Roads</td>
<td>96.4</td>
<td>12.4</td>
<td>4541</td>
<td>35.5</td>
<td>47.1</td>
</tr>
<tr>
<td>Collector Roads</td>
<td>98.9</td>
<td>12.7</td>
<td>1911</td>
<td>15.0</td>
<td>19.3</td>
</tr>
<tr>
<td>Freeways</td>
<td>13.3</td>
<td>1.7</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Highways</td>
<td>34.1</td>
<td>4.4</td>
<td>266</td>
<td>2.1</td>
<td>7.8</td>
</tr>
<tr>
<td>Local Roads</td>
<td>461.1</td>
<td>59.4</td>
<td>6011</td>
<td>47.0</td>
<td>13.0</td>
</tr>
<tr>
<td>Other Roads</td>
<td>72.2</td>
<td>9.3</td>
<td>57</td>
<td>0.5</td>
<td>0.8</td>
</tr>
<tr>
<td>Grand Total</td>
<td>776.0</td>
<td>100</td>
<td>12786</td>
<td>100</td>
<td>16.5</td>
</tr>
</tbody>
</table>

http://www.coquitlam.ca
Identifying Local Attractors

<table>
<thead>
<tr>
<th>Land Use Category</th>
<th>Units</th>
<th>% of All Units</th>
<th>Count of Crime Events</th>
<th>% of all Events</th>
<th>Records per 100 units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>35342</td>
<td>95.4</td>
<td>5267</td>
<td>54.9</td>
<td>0.2</td>
</tr>
<tr>
<td>Commercial</td>
<td>981</td>
<td>2.7</td>
<td>3390</td>
<td>35.3</td>
<td>3.5</td>
</tr>
<tr>
<td>Civic/Institution/Recreation (CIR)</td>
<td>507</td>
<td>1.4</td>
<td>897</td>
<td>9.4</td>
<td>1.8</td>
</tr>
<tr>
<td>Farm</td>
<td>79</td>
<td>0.2</td>
<td>10</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Industrial</td>
<td>78</td>
<td>0.2</td>
<td>23</td>
<td>0.2</td>
<td>0.3</td>
</tr>
<tr>
<td>Transportation, Communication, Utility (TCU)</td>
<td>49</td>
<td>0.1</td>
<td>6</td>
<td>0.1</td>
<td>0.1</td>
</tr>
<tr>
<td>Stratified Facilities</td>
<td>3</td>
<td>0.0</td>
<td>0</td>
<td>0.0</td>
<td>0.0</td>
</tr>
<tr>
<td>Grand Total</td>
<td>37039</td>
<td>100</td>
<td>9593</td>
<td>100</td>
<td>0.26</td>
</tr>
</tbody>
</table>

- Within these broad categories, several sub-types display higher crime rates:
  - Commercial: Shopping Centres (regional and community)
  - CIR: Schools, Hospitals
Crime Rates around Key Features

• With key built environmental features in hand (major roads, shopping centres, schools, hotels)
  – Create micro-buffers in 15 meter intervals
    • ArcGIS Network Analyst – Road Network based
  – Join crime event data to buffers
    • All events at site of feature itself are excluded
    • Results in a count of crime events at micro-distance intervals from features of interest
    • Rates standardized by total road distance

Key References: Groff (2011); Ratcliffe (2012)
Image: http://www.coquitlam.ca
Density of Crime Events by Distance From Arteries - 15m Intervals

Distance from Arteries - 15m Categories
- Crimes Against Persons
- Property Crimes
- Other Criminal Code Violations
- Drug Violations
- Other Federal Violations
- Traffic Offences
Density of Crime Events by Distance From Malls - 15m Intervals

Events Per Kilometer of Road

Distance from Malls - 15m Categories:
- Crimes Against Persons
- Property Crimes
- Other Criminal Code Violations
- Drug Violations
- Other Federal Violations
- Traffic Offences
Density of Crime Events by Distance From Schools - 15m Intervals

Events Per Kilometer of Road

Distance from Schools - 15m Categories
- Crimes Against Persons
- Property Crimes
- Other Criminal Code Violations
- Drug Violations
- Other Federal Violations
- Traffic Offences
Density of Crime Events by Distance From Hospitals - 15m Intervals

Distance from Hospitals - 15m Categories

- Crimes Against Persons
- Other Criminal Code Violations
- Other Federal Violations
- Property Crimes
- Drug Violations
- Traffic Offences
Discussion

• Macro – Meso – Micro level

• This method:
  – Identifies crime concentrations at micro areas beyond the key feature itself
  – Visualizes how these concentrations change across space
  – Emphasizes the different concentrations around different features

Image: http://www.coquitlam.ca
Reflections

• Emphasizes importance of micro-scale analysis
  – Benefits – increased detail and nuanced patterns
  – Drawbacks – increased variability

• Future Directions
  – Further distinction between crime types rather than broad categories
  – Explore patterns within other areas
Beyond the Hotspot:
Exploring the impact of Land Use and Transportation Networks on the Spatial Crime Distribution

wuschke@sfu.ca