



# Street profile analysis: A new method for mapping crime on major roadways



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## ARTICLE INFO

### Article history:

Received 10 November 2015

Received in revised form

16 February 2016

Accepted 21 February 2016

Available online 4 March 2016

### Keywords:

Crime mapping

Environmental criminology

Human movement

Street profile analysis

## ABSTRACT

Street profile analysis is a new method for analyzing temporal and spatial crime patterns along major roadways in metropolitan areas. This crime mapping technique allows for the identification of crime patterns along these street segments. These are linear spaces where *aggregate crime patterns* merge with *crime attractors/generators* and *human movement* to demonstrate how directionality is embedded in city infrastructures. Visually presenting the interplay between these criminological concepts and land use can improve police crime management strategies. This research presents how this crime mapping technique can be applied to a major roadway in Burnaby, Canada. This technique is contrasted with other crime mapping methods to demonstrate the utility of this approach when analyzing the rate and velocity of crime patterns overtime and in space.

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## 1. Introduction

Modern cities are transforming at a fast pace and adapting to the changing demands of urban living. Developing multi-use buildings and meeting transportation needs while maintaining livability and public safety is a primary planning strategy for many urban centers (Loukaitous-Sideris, 2014; Newton, 2004; Skogan, 2015; Smith, Phillips and King, 2010). These competing infrastructures can sometimes create very specific crime dynamics that if left unattended over time alter, or in some cases contradict, the original planning concept for an area (Knapp, 2013; Spicer, 2012). The new crime analysis technique presented in this paper can be used to identify areas where crime surges along major roadways and to compare these patterns to transecting roadways. This mapping technique can clearly visualize temporal variances, crime type comparisons and historical crime trends.

Street profile analysis is ideal for small and linear places where conventional analytical approaches are not fully suitable for visualizing of crime in these spaces. Most often, practitioners use maps to visualize crime patterns such as kernel density maps and aggregate address count maps (Chainey & Ratcliffe, 2005; Chainey, Tompson, and Uhlig, 2008; Eck and Weisburd, 2005). These

techniques are useful in presenting crime patterns throughout an area in order to expose crime hot spots and high crime locations. However, in order to demonstrate crime velocity or variance along a linear space, it may be preferable to engage in a graph approach, called *street profile analysis*, where the roadway is the x axis and crime count the y axis.

To the knowledge of the authors, this is a new crime mapping technique that can be utilized to study small urban areas along major roadways and to better understand the dynamics in these places. The research presented in this paper examines a major roadway in Burnaby, British Columbia. Burnaby in a jurisdiction in Metro Vancouver and the area under study contains several elements including a large regional shopping centre, a mass transportation station, a major roadway, a bike path, businesses and multi-dwelling residences. Several street profile views of this place are presented to demonstrate the variety of crime dynamics and the utility of this new mapping technique. A transect methodology is used in conjunction to compare and contrast roadways that bisect this major roadway.

From a practitioner perspective, street profile analysis is “user friendly” and can be produced using most analytical packages. The advantage of this approach is that it can clearly define where crime specifically peaks, both in space and in time, thus optimizing preventative strategies. Compared to techniques such as kernel density that diffuses the visual image of crime, this street profile technique sharpens the situation and can clearly demonstrate the problem. The street profile analysis is compared and contrasted to three

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other techniques. The strength and weaknesses of each technique is discussed.

## 2. Mapping framework

Environmental Criminology provides a theoretical framework for mapping crime in urban areas. Urban infrastructure and its impact on human movement and directionality influences crime occurrences by concentrating them into small, definable places. Crime analysis and mapping techniques can imbue these theoretical concepts into specific approaches that help to further define and understand these crime dynamics. The street profile mapping technique is based on these concepts of the urban infrastructure and is designed to demonstrate how crime occurs in small definable places and can surge due to specific dynamics in the environment.

### 2.1. City infrastructure

The urban infrastructure contains nodes, paths and edges where crime is concentrated (Brantingham & Brantingham, 1984). These are geographic spaces that also transition through temporal variances creating definable crime patterns (Brantingham & Brantingham, 1984, 1993a, b). Nodes are places where human activity is concentrated such as the crossing of two paths or an attractive place such as a mall. The crime patterns at nodes should be viewed as temporal because the activity at these places is not generally consistent. As a simple example, malls are not usually open 24 h per day therefore and the potential for shoplifting is completely eliminated by the closure of the mall while this same closure creates the potential for burglary.

Paths are channels designed for human movement (vehicle – pedestrian – mass transportation – bicycle or foot paths). Edges are boundaries between places that transition from one type of place to another such as a single-family dwelling area to a commercial zone. Like nodes, paths and edges transition through various temporal states that impact crime patterns. Within this framework, the street network is of interest because it links and defines the interaction between these elements (Brantingham & Brantingham, 2015; Davies & Johnson, 2015; Johnson & Summers, 2015; Vandever, Van Daele, & Vander Beken, 2015).

In certain places in the urban environment these three elements are consolidated and in some ways compressed along certain street segments. This can create crime surges and the street profile analysis can locate these places, then assist in analyzing the temporal and crime dynamics. In particular, major roadways that contain activity nodes, high volume pathways and edges are susceptible to these crime dynamics. Within this context, the street profile analysis can display the variance in crime density in a manner that clearly defines the impact of these three elements on crime patterns.

### 2.2. Effectively mapping small places

Crime place theory focuses on crime events in small places such as specific addresses, business types and block faces (Eck and Weisburd, 1995). These small places can be categorized by feature, cluster or facility (Eck and Weisburd, 1995). Features include aspects such as physical or social structure, while clusters can be understood as hot or cool spots, and facilities, or addresses, are places such as bars, problem premises, or parks (Eck and Weisburd, 1995).

Major roadways contain successive small places that create variability and sudden increases in criminal events along their trajectory. In a spatial analysis of street segments in Seattle, WA,

Groff, Weisburd and Yang (2010) found that contiguous street segments could have very different (sometimes opposite) trajectories. These increases or decreases in crime can be better understood using the elements defined in crime place theory (features – clustering – facilities). For instance, the presence of a facility like a mall on a major roadway produces criminogenic features such as reduced guardianship and increased target opportunity, and also creates a clustering of criminal events that may lead to small places next to one another having very different crime patterns. Another example is a strip of licensed establishments also generating a crime surge.

The street profile analysis can describe the linearity of a major roadway while at the same time exposing the multiple variances that can occur in such a place. In particular, this graph technique simplifies crime patterns and can produce comparisons on a single graph which allows for detailed analysis of crime, place and time.

### 2.3. Visualizing the effect of crime attractors and crime generators

Crime attractors and crime generators are both small places with specific characteristics that make them higher crime areas (Brantingham & Brantingham, 1995). Crime generators are places that attract a large number of people such as a shopping or entertainment district, or a sporting venue. They produce crime because there are many people in attendance and also many potential targets, thus the opportunity for crime is present, *en masse*. Crime attractors are also small places, however these are well-known for their criminal opportunities and, therefore, attract criminals. Strongly motivated offenders, usually not from that area, attend these places for criminal purposes. Some examples of crime attractors are drug or prostitution markets, or shopping malls near a major transit hub.

Crime patterns along major roadways may vary because of the number and size of crime attractors and generators they contain. Major roadways are linear spaces in the urban infrastructure that often bisect multiple neighborhoods. Crime peaks along these roadways, and their variance through time and crime type, can be better explained using the concepts of attractors and generators. As well, when considered longitudinally, the variation in crime peaks or the emergence of a crime surge may be the result of a generator turning into an attractor. The street profile analysis technique exposes crime attractors and generators by clearly defining crime density along the roadway.

### 2.4. Conceptualizing urban directionality

The relationship between urban directionality and crime has a long history founded on the concept of spatial criminology (Frank, Andresen, Cheng, & Brantingham, 2011; Rengert & Wasilchick, 1985). Research has demonstrated the influence of crime on macro urban directionality through the criminal attractiveness of town centers, the impact of mass transportation and the formation of criminogenic streets and neighborhoods (Herrman, 2013; Song, Spicer, Brantingham and Frank, 2013). The micro and individual aspect of directionality is explained by the geometry of crime (Brantingham & Brantingham, 1981). This perspective helps explain and further clarify factors such as temporal constraint (Ratcliffe, 2006), directional bias by crime type (Van Daele & Bernasco, 2012), and more recently the directional bias of repeat property offender within a large-scale sample (Frank, Andresen, & Brantingham, 2012; Frank et al., 2011).

The analysis of major roadways is a meso analysis of urban directionality. Within large metropolitan cities there are smaller sub-sets of areas and pathways where human activity is concentrated for various reasons. These may include attractive pedestrian

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