# Do crime generators exist in a developing context? An exploratory study in the township of Khayelitsha, South Africa

Gregory D. Breetzke[1] & Ian S. Edelstein[2]

[1] Department of Geography, Geoinformatics and Meteorology, University of Pretoria, Pretoria, 0002, South Africa

[2] Safety and Violence Initiative, University of Cape Town, Private Bag X3, Rondebosch, 7701, South Africa

## Abstract

Crime generators are places that increase the risk of crime occurring due mainly to the fact that they attract a large number of motivated offenders and suitable targets to a particular location. Research identifying crime generators has however almost exclusively been confined to the United States and Europe with much less known about the ability of businesses, institutions, and/or public facilities to generate crime in less developed contexts, particularly in Africa. In this study we explore whether four different types of facilities act as crime generators in a setting axiomatically different to the West, namely Khayelitsha, a township located on the urban periphery of Cape Town in South Africa. Using intensity value analysis (IVA), we examine the intensity of assault, robbery, and rape around four different types of facilities (schools, recreational hubs, transport interchanges, and alcohol outlets) relative to other random locations in Khayelitsha. The results of our research suggest that schools, and to a lesser extent transport interchanges and recreational hubs, may act as crime generators in the township. Possible explanations for these findings conclude.

**Keywords:** crime generators, Khayelitsha, intensity value analysis, South Africa, crime

**Introduction**

Research has exhaustively shown that crime does not randomly occur but rather spatially concentrates (Sherman *et al*, 1989; Nelson *et al*, 2001; Weisburd *et al*, 2012). Spatial crime researchers generally seek to identify the causes of these concentrations which can occur at broadly three levels of aggregation: macro-, meso- and micro-levels (Brantingham and Brantingham, 1998). Macro-level analysis involves the analyses of crime in cities or large areas within a particular country while meso-level analysis involves the analysis of crime within the sub-areas of a city or within a smaller metropolitan area. Finally, micro-level analysis examines crime at the street segment level or at certain specific built environment locations. Regardless of the level of aggregation, in most instances scholars are focused on examining how population characteristics, and/or degrees of social relationships and linkages among community residents may be influential in the occurrence of crime. Other facilities within the built environment of communities, and their spatial association with crime, are also considered and can include facilities such as schools (Hewitt *et al*, 2018), alcohol outlets (Conrow *et al*, 2015), shopping centers (Kinney *et al*, 2008), sexually orientated businesses (McCord and Tewksbury, 2013), and parks (Groff and McCord, 2012) among a plethora of others. In most instances researchers aim to understand whether these types of facilities are 'criminogenic' in nature, most often controlling for socio-demographic context. Facilities that are most often found to increase the risk of criminal victimization have been termed 'crime generators' (Brantingham and Brantingham, 1991) or 'risky facilities' (Eck *et al*, 2007) in previous work with the notion being that their mere presence can influence crime levels in the surrounding areas.

South Africa is a country synonymous with crime. While official crime statistics for 2018/2019 indicate that crime overall is on the decrease, certain categories of crime such as murder, sexual offences and assault continue to rise, with murder remaining particularly high

with roughly 58 murders being committed per day in the country (South African Police Services (SAPS), 2019). Like much international spatial crime research has shown, the distribution of crime in South Africa is not uniform but rather concentrated in a relatively small number of locations (see Hiropolous and Porter, 2014; Breetzke and Edelstein, 2019). In fact, recent research has shown how the vast majority of crime in the country is concentrated in former 'township' settings (Breetzke, 2018). In South Africa, the term township refers to the largely underdeveloped urban areas that were reserved for Indians, black Africans and Coloureds under apartheid. Townships such as Khayelitsha were built on the urban periphery and were, and most often still are, synonymous with extreme poverty and socio-economic deprivation (Kynoch, 2005), and concomitant high and violence crime levels (Kynoch, 2003; Breetzke and Edelstein, 2019). Currently, the ten most violent police precincts in South Africa are all located in former township areas (Crime Stats, 2019) including the township of Khayelitsha, located on the urban periphery of Cape Town.

In this exploratory study, we examine whether certain facilities in the township of Khayelitsha may act as generators of crime. Specifically, we explore the spatial distribution of assault, robbery and rape in Khayelitsha from 2006 to 2016 around four different types of facilities (schools, alcohol outlets, transport interchanges, and recreational hubs) using intensity value analysis. In doing this research, we aim to advance **and broaden the foundations of** criminological thought as previous research identifying crime generators has largely been confined to the United States with much less known about the viability of 'crime generators' as a concept in less developed contexts, especially in Africa.

**Literature review**

Arguably the key theory used to explain the spatial distribution of crime around facilities is the crime pattern theory of Brantingham and Brantingham (1991). This spatial theory of crime

**asserts** that crime is most likely to occur where places perceived by the offender to contain attractive targets (opportunity spaces), intersect with places about which an offender has specific knowledge (awareness spaces). Relatedly, activity nodes refer to locations where people regularly spend a significant proportion of their time, such as shopping centres, recreational hubs, schools, and workplaces (Drawve *et al*, 2016). General movements of individuals towards and away from their activity nodes can increase the likelihood of crime events in these locations (Malleson and Andresen, 2016). Activity nodes are akin to another central concept in crime pattern theory, namely crime generators and crime attractors. Crime generators are places that generate crime simply because a lot of motivated offenders and suitable targets are brought together in space and time by virtue of their legitimate routine activities such as commuting or going to school. Crime attractors on the other hand are places that do not necessarily bring together large groups of people at the same time, but their function makes them well suited for motivated offenders to find suitable targets (Bernasco and Block, 2011). For example, small businesses such as bars, fast-food restaurants, and gas stations have cash economies and may attract property offenders who generally prefer items that are concealable, and removable (Clarke, 1999; Wellsmith and Burrell, 2005). It is important to note that, at times, an activity node can be both a crime generator as well as a crime attractor. For example, a park can be an attractor for certain types of people to offend such as drug dealers (Knutsson, 1997; Groff and McCord, 2012) but could also act as a crime generator in that a park attracts a large number of legitimate users of the space (i.e., joggers, picnic-goers) but in doing so also increase their risk of victimization.

Both crime generators and crime attractors build upon the concepts and mechanisms of another seminal spatial theory of crime, namely routine activities (RA) theory (Cohen and Felson, 1979). The RA theory provides a simple yet attractive insight into the causes of criminal behavior and advocates that the risk of crime occurring increases when there is a convergence

in space and time of three minimal elements: a motivated offender, a suitable target, and the lack of a capable guardian. Crime generators (crime pattern theory) such as schools, for example, are visited by individuals as part of their daily routine (routine activities theory) which may increase the risk of certain types of criminal victimization as the risk of convergence of the three essential elements of the RA theory increases. Lemieux and Felson (2012) compared the association between different types of daily activities and the risk of victimization and found that 'attending school' and 'leisure activities away from home' were associated with a high risk of victimization, though 'travelling to or from work' and 'travelling to or from school' presented the highest risk of victimization. Importantly, the RA theory postulates that changes in routine or typical activities increase the probability that individuals or households will be exposed to certain types of criminal victimization. Likewise, an increase in the number of crime generators (crime pattern theory) that an individual routinely visits per day (i.e., shopping mall, gym) will likely increase the risk of crime as these locations are accessible and popular and attract a large number of people thereby increasing the number of suitable targets (RA theory).

Unsurprisingly, a large number of studies have examined whether certain types of facilities generate crime. Key studies related to this research in particular include Roman (2003) who examined whether the presence of *schools* was spatially associated with violent crime in Maryland and found higher rates of crime in neighbourhoods with a higher proportion of schools. More recent work by Osborne, McCord and Higgins (2016) in the District of Columbia found that the crime-generating power of schools was greater in neighborhoods with a higher percentage of the population living in poverty while Hewitt *et al*. (2018) also found similar effects but in neighborhoods with a higher percentage of single residents in Vancouver, Canada. Most prior research has found a positive association between the presence of schools in a community and crime across a range of different categories (see McCord *et al*, 2007;

Osborne *et al*, 2016; Hewitt *et al*, 2018), with a few notable exceptions (see Kautt and Roncek, 2007; Murray and Swatt, 2013).

*Public transport interchanges* such as bus and/or train stops may also act as crime generators in that they bring a large number of individuals together most often for commuting reasons although in a South African context, the areas surrounding transport interchanges also attract informal traders. Although the types of crimes that most often occur in and around transport interchanges may be relatively minor (see Gallison and Andresen, 2017), the general lack of supervision and social cohesion at these locations increase the risk of crime occurring (Ceccato and Newton, 2015). Previous research in various contexts has found a positive spatial association between the presence of public transport facilities and a range of different crime types (Newton *et al*, 2014; Irvin-Erickson and La Vigne, 2015; Badiora *et al*, 2015). Anecdotal evidence in South Africa suggests that public transportation facilities, especially taxi ranks, are criminogenic settings (Page, 2001) commonly targeted by offenders for crimes ranging from pickpocketing to more serious offences such as rape, although no empirical research has been undertaken to support these assertions.

Numerous studies have been conducted over the past 20 years examining the relationship between crime and access to *alcohol outlets*. Researchers have applied a range of study and research designs and most often found positive and statistically significant relationships between crime and alcohol availability (Freisthler *et al*, 2004; Britt *et al*, 2005; Day *et al*, 2012). In terms of scale, spatial studies examining the relationship between crime and alcohol have been conducted at increasingly finer levels, with the finest being point-based associations where researchers have found that the strength of the association between crime and alcohol outlets is highly dependent on the outlet type (Pridemore and Grubesic, 2013) as well as the time at which the incident occurred (Conrow *et al*, 2015). At a broader level, a plethora of studies have explored this association with the 'neighborhood' as the level of spatial analysis.

As anticipated by crime pattern theory, the general consensus of this literature is that an increase in alcohol availability increases crime rates even after accounting for various endogenous factors such as disadvantage, poverty, instability, and various population characteristics (Scribner *et al*, 1995; Speer *et al*, 1998; Gorman *et al*, 2001; Zhu *et al*, 2004).

In truth, the facilities we outlined above could be considered crime generators and/or crime attractors, dependent on the context. However in the current study we consider them mainly as crime generators simply because these facilities primarily attract large numbers of non-residents, the majority of whom, do not have criminal intent but rather use these facilities as an essential part of their daily routine. Moreover, facilities classified as crime attractors most often have criminal reputations (e.g., drug markets, brothels) and are associated with increased crime because people seek them out to achieve a criminal goal (Groff and Lockwood, 2014); this is not usually the case with the facilities we have chosen to examine in this study.

The present study aimed to examine the point-based spatial association between three different types of crime (assault, robbery, and rape) and four different types of public facilities (schools, public transport interchanges, recreational hubs and alcohol outlets) in Khayelitsha. Khayelitsha was established by the former apartheid government in 1983 to accommodate mainly Xhosa-speaking black African families that were living in former whites-only areas of Cape Town. Over a period of time non-white residents (black African and Coloured) were, in most instances, forcibly removed from 'race islands' in central Cape Town and relocated to an expansive low-lying area situated 30 kilometers to the southeast of Cape Town, commonly referred to as the 'Cape Flats'. Khayelitsha (pop. 400,000) is one of the poorest townships on the Cape Flats with an estimated 32% to 46% of households in the township living in severe poverty (World Economic Forum, 2016). Crime is also rampant with the murder rate consistently over 80 per 100,000 residents, almost double the national average (Crime Hub, 2018). With the notable exception of Hiropolous and Porter (2014), no prior research has

examined whether crime generators not only exist in South Africa, and indeed Africa in general, but investigated whether crime generators exist in a location of uniform poverty and disadvantage. To that end, this study aims to make a contribution.

**Data and method**

*Crime data*

Crime data for the research was obtained from the South African Police Services. The 'Greater Khayelitsha reporting area' consists of three police precincts: Khayelitsha, Harare, and Lingelethu. We only had access to police data for the Khayelitsha policing precinct for this research (population roughly 160,000). The crime data obtained included attributes such as the incident id, the type of offence, the date and time of the offence and the x- and y-coordinate for the period 2006 – 2016. From this dataset we extracted assault (n = 13593), robbery (n = 6848), and rape (n = 1807) offences. The selection of these three crime types was driven largely by the fact that they all involve direct contact with an individual and exhibit a greater impact on an individual's sense of safety and security. We were also interested in selecting a violent crime (assault), a property crime (robbery), and a sexual crime (rape) in order to determine whether these three different crime types exhibit similar intensities around public facilities in the township.

*Facilities data*

Data on the location of public facilities in Khayelitsha were obtained from the City of Cape Town Open Data Portal (https://web1.capetown.gov.za/web1/OpenDataPortal/). The dataset contained a range of public facilities in the township from which we extracted three different types: public transport interchanges (n = 14),  recreational hubs (n = 8), and schools (n = 20).

Public transport interchanges include train stations and taxi ranks. Recreational hubs included facilities such as libraries, community centers, and swimming pools. All 20 schools included in the analysis were non-fee paying schools (and included both primary and secondary schools). Finally, data regarding the location of alcohol outlets (n = 8) were obtained from the Western Cape Liquor Licensing Authority. An alcohol outlet is a place where alcohol may be legally purchased, either on-premises (bars or restaurants) or off-premises (liquor stores). This resulted in a total of 50 facilities being examined across the four different types. Data pertaining to the neighbourhood spatial boundaries and census data of Khayelitsha were obtained from Statistics South Africa (2011).

*Analysis*

A cross-sectional quantitative research design was employed to examine the extent to which the four identified types of public facilities may increase an individuals' risk of criminal victimization. Intensity value analysis (IVA) was used to determine the intensity of crime surrounding each facility and the mean intensity value was aggregated and calculated per type of facility. The mean intensity values were then compared between the four types of facilities as well as against a series of 100 points (street intersections) randomly generated across the township. According to McCord and Ratcliffe (2009) IVA involves calculating the intensity of crime points found within a certain buffer interval of a facility into a single, inverse distance-weighted value based on the aggregate proximity of all crime incidents found within the buffer area surrounding each facility. Crime points located farther from a facility are assigned lower values and crime points located closer to a facility are assigned higher values depending on the weighting regime employed. The weighting scheme can follow a simple linear design, as

9

shown in Equation 1 below, or other more advanced non-linear weighting regimes. The intensity measure is calculated as follows:

$$\lambda_\tau(r) = \sum_{d_i \leq \tau}(1 - \frac{d_i}{\tau}) \qquad \text{(1)}$$

Where $\lambda\tau(r)$ is the intensity value for a public facility $r$ given a buffer distance $\tau$, where $\tau > 0$, and $d_i$ is the distance between the facility and a crime point within the buffer distance.

In the study, we calculated IVAs for a series of buffer intervals immediately surrounding each public facility for each year under investigation (2006 to 2016) and then aggregated them to create a combined mean IVA for each facility type per buffer interval. This was done in order to determine the impact of a public facility on crime in the areas adjacent to them. It could be that offenders are deterred by the safety and security measures possibly in place at certain public facilities and instead are inclined to commit offences more easily nearby. In this way, we assert that the facilities examined in this study may be considered 'protected' crime generators in that the opportunity for crime to occur is diminished at the facility itself due to the possible increased risk posed by various situational crime prevention measures such as security guards, and CCTV cameras, among others.

Euclidean buffer intervals of 100 meters and 200 meters were constructed around each facility due to the informal nature of portions of the road network in the township restricting conventional road network buffers as well as the fact that the township has an extremely high population density. The distances used also broadly approximate a township 'block'. Last, we tested the results obtained against the extent of crime occurring around a randomly selected set of 100 street intersections in the township. For each of these 100 randomly selected street intersections, we constructed similar buffers intervals and calculated IVAs for these areas. In this way, we have a 'control' group for comparison which provides additional validity to the

study. If the IVA for the density of crime around public facilities is higher than for the 100 random points then we can be more certain of the association between pubic facilities and crime in the township.

**Results**

Descriptive statistics of the population and crime in Khayelitsha per small area layer (SAL) ($n$ = 254) are shown in Table 1. The SAL is the smallest unit of analysis for which Statistics South Africa disseminates spatial information, with each SAL in Khayelitsha containing 630 people, on average. One notable observation from these statistics is the extremely high population density in the township with the SAL with the highest population density exhibiting a staggering 34950 people per square kilometer. Overcrowding is a common phenomenon in townships across South Africa, but it is particularly problematic in Khayelitsha, given its close proximity to Cape Town, as well as it being a popular location for migrants from other parts of the country. Indeed, approximately 62% of resident of Khayelitsha are rural-to-urban migrants (Statistics South Africa, 2011).

**Table 1:** Descriptive statistics of the population and crime in Khayelitsha per SAL ($n = 254$)

|  | N | Min | Mean | Max | SD |
|---|---|---|---|---|---|
| Population | 159827 | 20 | 629.24 | 1603 | 256.12 |
| Area (km$^2$) | 9.32 | 0.01 | 0.04 | 1.90 | 0.13 |
| Density (pop/km$^2$) | 17148.82 | 43.23 | 34949.52 | 113518.49 | 18382.96 |
| | | | | | |
| *Crime characteristics*[a] | | | | | |
| Assault | 13593 | 0 | 0.92 | 16.22 | 1.50 |
| Robbery | 6848 | 0 | 0.45 | 9.55 | 0.84 |
| Rape | 1807 | 0 | 0.12 | 1.83 | 0.19 |

[a] Min, mean, max and standard deviation in mean annual rate per 100 population per year (2006-2016)

The results of the IVA for assault are presented in Table 2. The highest mean intensity value for assault at the 100 meter buffer distance was found for recreational hubs (IVA = 24.61, $p > 0.05$), followed by transport interchanges (IVA = 22.58, $p > 0.05$) and schools (IVA = 22.34, $p > 0.05$). The mean intensity value for the 100 random points was, notably, the lowest recorded value at the 100 meter buffer distance. There was very little variation in the mean intensity values across facility types and no values differed significantly from the 100 random points ($p > 0.05$). At the 200 meter buffer distance, two types of facilities (schools (IVA = 107.44, $p < 0.005$) and transport interchanges (IVA = 79.88, $p < 0.05$)) were found to exhibit significantly higher intensity values than the random points. Moreover, roughly 90% of schools and almost 80% of transport interchanges had more than 50 assaults recorded within 200 meters over the 10-year study period.

In contrast to assault, the highest mean intensity value for robbery at the 100 meter buffer distance was found for transport interchanges (IVA = 17.14, p < 0.005) (see Table 3). This facility was also the only type to exhibit significantly higher intensity values than the 100 random points. Again, the mean intensity value for the 100 random points was the lowest recorded value at the 100 meter buffer distance. At the 200 meter buffer distance, schools (IVA = 53.26, $p < 0.05$), recreational hubs (IVA = 66.24, $p < 0.05$) and transport interchanges (55.58, $p < 0.05$) were all found to exhibit significantly higher intensity values than the random points. Finally, only one significant result was found for rape across all four facility types and buffer distances and that was for schools at the 200 meter buffer distance where the mean intensity value was found to be significantly higher than 100 random points (see Table 4; IVA = 14.39, $p < 0.005$). The fact that the mean intensity value for the 100 random points was, again, the lowest at both buffer distances for rape indicates that the four types of facilities examined have higher intensities surrounding them for all crime types, albeit not necessarily significantly higher, but worth noting. Overall, the findings suggest that both schools, transport interchanges

**Table 2:** Mean IVA of assaults and percent of facilities with at least 50 assaults in close proximity to a facility

| Facilities | No. of facilities | Mean IVA of assaults within 100m | Range (min, max) | % of facilities with 50 or more assaults within 100m | Mean IVA of assaults within 200m | Range (min, max) | % of facilities with 50 or more assaults within 200m |
|---|---|---|---|---|---|---|---|
| Schools | 20 | 22.34 | (1.83, 51.82) | 60 | 107.44** | (12.23, 262.93) | 90 |
| Alcohol outlets | 8 | 22.09 | (9.06, 51.26) | 50 | 82.81 | (35.66, 138.06) | 100 |
| Recreational hub | 8 | 24.61 | (4.99, 54.84) | 62.5 | 110.6 | (25.79, 201.58) | 100 |
| Transport interchange | 14 | 22.58 | (0.19, 102.21) | 42.9 | 79.88* | (0.59, 236.11) | 78.6 |
| Random points | 100 | 15.01 [a] | (0, 148.43) | 35 | 58.22 | (0, 375.90) | 65 |

*$p<0.05$, **$p<0.005$, ***$p<0.001$
[a] Facility type: Random points vs. the other facilities


**Table 3:** Mean IVA of robberies and percent of facilities with at least 50 robberies in close proximity to a facility

| Facilities | No. of facilities | Mean IVA of robberies within 100m | Range (min, max) | % of facilities with 50 or more robberies within 100m | Mean IVA of robberies within 200m | Range (min, max) | % of facilities with 50 or more robberies within 200m |
|---|---|---|---|---|---|---|---|
| Schools | 20 | 10.36 | (0.26, 25.75) | 30 | 53.26* | (9.06, 96.51) | 85 |
| Alcohol outlets | 8 | 13.89 | (6.42, 27.88) | 25 | 48.57 | (23.79, 102.90) | 100 |
| Recreational hub | 8 | 14.1 | (1.62, 32.04) | 37.5 | 66.24* | (12, 150.32) | 100 |
| Transport interchange | 14 | 17.14** | (0, 57.36) | 42.9 | 55.58* | (1.14, 115.04) | 64.3 |
| Random points | 100 | 7.57[a] | (0, 33.69) | 12 | 30.33 | (0, 136.86) | 55 |

*$p<0.05$, **$p<0.005$, ***$p<0.001$
[a] Facility type: Random points vs. the other facilities

**Table 4:** Mean IVA of rapes and percent of facilities with at least 50 incidents of rape in close proximity to a facility

| Facilities | No. of facilities | Mean IVA of rape within 100m | Range (min, max) | % of facilities with 50 or more rape within 100m | Mean IVA of rape within 200m | Range (min, max) | % of facilities with 50 or more rape within 200m |
|---|---|---|---|---|---|---|---|
| Schools | 20 | 3.19 | (0, 9.61) | 0 | 14.39** | (0.89, 31.77) | 40 |
| Alcohol outlets | 8 | 2.82 | (1.24, 6.16) | 0 | 10.16 | (2.69, 18.89) | 12.5 |
| Recreational hub | 8 | 3.22 | (0.58, 5.69) | 0 | 13.1 | (4.29, 20.22) | 37.5 |
| Transport interchange | 14 | 3.04 | (0, 15.22) | 0 | 9.81 | (0.52, 33.48) | 14.3 |
| Random points | 100 | 1.92 [a] | (0, 18.58) | 0 | 7.61 | (0, 45.39) | 14 |

*$p<0.05$, **$p<0.005$, ***$p<0.001$
[a] Facility type: Random points vs. the other facilities

and, to a lesser extent, recreational hubs may act as crime generators in the township of Khayelitsha with these types of facilities exhibiting higher mean intensity values than the other facility types as well as the set of random points.

**Discussion**

Public facilities present opportunities for motivated offenders as they are most often freely accessible and available, leading to an increased risk for of victimisation among people. Likewise, the areas surrounding public facilities could also attract potential offenders as large numbers of people travel to and from these locations, reducing the effectiveness of informal, neighborhood social controls. Previous international research has shown that criminal activity is often highly concentrated in and around such locations (Eck *et al*, 2007; Kurland *et al*, 2014; Boessen and Hipp, 2018). However, the majority of these studies have been conducted in the United States and, to a lesser extent, Europe, with much less known about public facilities as crime generators in less-developed contexts, including Africa. This exploratory study aimed to begin to fill this void by identifying possible generators of crime in an area of extreme poverty and concentrated disadvantage in South Africa. The spatial intensity of crime around four different types of public facilities in the township of Khayelitsha was analysed over a period of ten years (2006 – 2016). In our analysis, we found that the mean intensity value of all three crime types (assault, robbery and rape) was significantly higher at the 200 meter buffer distance around schools than around each of the 100 randomly selected points. Indeed, the highest intensity value for any type of crime surrounding any type of facility was found for assault at the 200 meter buffer interval around schools (IVA = 107.44, $p < 0.005$). The explanation for crimes exhibiting a greater mean intensity at the 200 meter buffer distance is speculative but could be related to the increased security at the facilities themselves. Individuals going about their routine activities may be deterred by various types of security measures at schools, and

transport interchanges and not commit an opportunistic crime based on the perceived risk. Outside of the immediate vicinity of the facility however these measures may be largely absent, increasing the opportunity for crime to occur. The number of individuals surrounding each facility is also lower reducing the extrinsic risk associated with committing each offence. Bowers (2014) uses the term crime 'radiators' to describe facilities that exhibit high crime levels in their surrounding environment. The researchers found a strong positive relationship between crime occurring both within and surrounding facilities in a Metropolitan area in the United Kingdom.

The notion that schools may be considered as possible crime generators is supported by prior international research (McCord *et al*. 2007; Osborne *et al*. 2016; Hewitt *et al*. 2018). Over thirty years ago, studies found that residential areas that were adjacent to public high schools had higher crime rates than areas farther away (Roncek and LoBosco, 1983; Roncek and Faggiani, 1985). More recent studies have also identified schools as possible crime generators (McCord *et al*, 2007; Osborne *et al*, 2016; Hewitt *et al*, 2018). In South Africa, a recent study by Breetzke, Fabris-Rotelli, Modiba and Edelstein (in press) found significant spatial clustering of sexual violence around schools in Khayelitsha and attributed this, in part, to the disorganised areas immediately adjacent to schools in the township creating a dangerous environment for people in these vicinities, particularly on pedestrian routes. Indeed, a study by Simons *et al*. (2018) found that the areas surrounding schools in Khayelitsha were under-serviced and under-resourced with poorly defined and maintained footpaths, and poor lighting which may present an increased opportunity for motivated offenders to target users. Schools are, however, omnipresent in all types of communities and are frequently, in developing countries at least, in close proximity to other types of facilities such as informal alcohol outlets, despite zoning restrictions increasing the associated risk of crime.

In our analysis, transport interchanges were also identified as possible crime generators in Khayelitsha. Anecdotal evidence suggests that the locations immediately surrounding transport interchanges in townships in South Africa are prone to violence (Dordley, 2018; Anciano and Piper, 2019). Taxi ranks, in particular, are known locations of violence between rival taxi associations clashing over taxi routes between the outlying townships and the Cape Town Central Business District. In fact, a number of taxi ranks and routes have been closed, albeit temporarily, over the past two years by the City of Cape Town due to such violence (Dordley, 2018). Crime surrounding train stations-and on trains en route -is also prevalent with numerous instances of violence reported in and around train stations over the past decade (Daniel, 2018; Payne, 2019). Recent research indicates that 43% of former passengers have stopped riding trains in South Africa over the past four years due mainly to fears of safety and security (#UnitedBehind, 2019). The researchers note that women and children are particularly vulnerable to crime on trains and at train stations, and that Metrorail – the state-run surface rail network – is bankrupt and simply unable to provide protection for train commuters. The results of our research suggest, for the first time, an empirical link between these commuter stops and the prevalence of crime.

Of course, the limitations of this study must be considered. First, it could be that the increased spatial intensity of crime around schools and transport interchanges, in particular, may not be related to the presence of these facilities themselves but could simply be a criminogenic manifestation of the broader built, social, economic and cultural environment. If this study we did not control for the so-called underlying environmental backcloth. This concern is valid; however, much of the appeal of using a technique such as IVA is its simplicity. The tool is purely an exploratory measure which allows users to determine more broadly the intensity of crime relative to 'control' locations. According to McCord and Ratcliffe (2009) one of the many benefits of using IVA over another similar geospatial technique such as

location quotient analysis is the ability of IVA to handle potential inaccuracies in geocoding. In practice, crime points may not be geocoded accurately and these geocoding errors can propagate when crime incidents are attributed to have occurred within a buffer when in fact, they are located outside the buffer area. A crime point inaccurately geocoded within a buffer is always assigned a weight of one in location quotient analysis. However, IVA would likely assign a much lower value to this point based upon the inverse-distance weighting scheme that adjusts for the distance to the investigated facility. This assigned value difference may prove substantial when the intensity values are used in statistical analyses are summed, thus minimising some geocoding error impact. This final benefit of using IVA is particularly relevant in a South African context where the accuracy of geocoding of crime has been brought into question over a long period of time (see Schwabe, 2000; Breetzke, 2006; Edelstein and Arnott, 2019).

Second, there are a relatively small number of public facilities that are included in the analysis ($n = 50$). In truth, there are very few community facilities in Khayelitsha due mainly to spatial legacy left by the apartheid government's regional development policies. These policies led to the gross inequitable distribution of infrastructure, resources and services by space and concomitantly, race. The result is the fact that the first shopping mall in Khayelitsha only opened in 2005 and there are currently only a handful of community facilities in the township. Relatedly, the examination of only eight alcohol outlets as possible crime generators in Khayelitsha is problematic due to the exclusion of illegal and/or unregistered outlets in the township. Research has shown that this official number is a gross undercount of the true number of alcohol outlets available in the township (Matzopoulos *et al*, 2017). The data we have obtained, however, is the only official and spatially replete record of licensed outlets registered in Khayelitsha by the Western Cape Liquor Licensing Authority. Our results indicate that legal alcohol outlets do not act as crime generators in the community, an important result.

18

Future research can map and examine whether illegal and/or unregistered outlets act in this capacity, or exhibit crime generating characteristics. A comparison between both sets of alcohol outlets would be valuable.

Third, the four types of facilities highlighted in this research are described as crime generators whereas, in fact, they could easily also be considered as crime attractors as well. Without more detailed crime information - relating both to the offence as well as the offender (if apprehended) - available to us it is difficult to determine the nature, means and motives of the incident making an explicit reference to the facilities as crime attractors problematic. It is possible that crime generators may *become* crime attractors due to the unique opportunities they provide (Bernasco and Block, 2011) but without information on the crime event we felt it more pertinent to refer to the facilities as crime generators.

Finally, the study is context-specific and are applicable to Khayelitsha; a partially informal, extremely dense, and disadvantaged township location located on the urban periphery of Cape Town. The associations we observed in this study may not necessarily hold true in other cities and/or townships in South Africa or in similar contexts, internationally. Conversely, it could also be that stronger patterns are observed in other developing contexts. Future research should aim to replicate this type of research in other developing cities which are distant and distinct from Khayelitsha, taking the other limitations into account as well.

**Conclusion**

Once described as "the most ambitious contemporary exercise in applied geography" (Smith, 1982, p.1), apartheid, and its legacy, continues to define South Africa's social, economic, and built environments. It also largely continues to define crime and its distribution across the country. Crime is a cancer, particularly in township communities of South Africa, and any attempt to explicate its causes is valuable. In this exploratory research, we found evidence that

certain public facilities in Khayelitsha may be crime generators, notably schools and transport interchanges. In doing so, we were able to provide some key insights vital for law enforcement agencies, non-governmental organisations, and other relevant stakeholders responsible for crime prevention and crime reduction in Khayelitsha. From a practical perspective the identification of certain types of facilities as crime generators can assist in the prescribing of policies that work to reduce the risk of crime occurring at these facilities. Operationally, the SAPS could implement various types of situational crime prevention measures in and immediately surrounding schools and transport interchanges specifically. Other types of policing measures could be undertaken around these facilities such as vehicle and foot patrols, checkpoints, and stop-and-search operations. At the tactical level, intelligence garnered from knowing which types of facilities are at a greater risk of crime can be used to guide policing units to specific locations and individuals linked to criminal activities, potentially leading to the arrest of suspects and suspicious persons.

Finally, we believe that the results of our research provides a measure of academic credibility and generalisability to a concept, namely crime generators, that is widely accepted and acknowledged by environmental criminologists. Although the association between crime and place is more contextual than causal, it is still real nonetheless, particularly in developing contexts such as South Africa where a history of socio-spatial segregation continues to define the urban geography landscape.

**Conflict of interest**

On behalf of all authors, the corresponding author states that there is no conflict of interest.

**References**

#UniteBehind. (2019) Available at: https://unitebehind.org.za/wp-content/uploads/metrorail-pamphlet-black-and-white.pdf, accessed 2 February 2020.

Anciano, F. and Piper, L. (2019) Cape Town's taxi violence - rooted in attempts to govern competition, https://www.fin24.com/Opinion/cape-towns-taxi-violence-rooted-in-attempts-to-govern-competition-20190420-2, accessed 2 February 2020.

Badiora, A. I, Ojewale, O. S. and Okunola, O. H. (2015) Perceived risk and fear of crime in public transport nodes: The experience from Nigerian transit environment. *International Journal of Criminal Justice Sciences* 10(2): 139-151.

Bernasco, W. and Block, R. (2011) Robberies in Chicago: A block-level analysis of the influence of crime generators, crime attractors, and offender anchor points. *Journal of Research in Crime and Delinquency* 48(1):33-57.

Boessen, A. and Hipp, J. R. (2018) Parks as crime inhibitors or generators: Examining parks and the role of their nearby context. *Social Science Research* 76: 186-201.

Bowers, K. (2014) Risky facilities: Crime radiators or crime absorbers? A comparison of internal and external levels of theft. *Journal of Quantitative Criminology* 30: 389–414.

Brantingham, P. J. and Brantingham, P. L. (1991) *Environmental Criminology 2nd Ed*. Prospect Heights, IL: Waveland Press.

Brantingham, P. L. and Brantingham, P. J. (1998) Mapping crime for analytic purposes: Location quotients, counts, and rates. *Crime Mapping and Crime Prevention* 8: 263-288.

Breetzke, G. D. (2006) Geographical Information Systems (GIS) and policing in South Africa: A review. *Policing: An International Journal of Policing Strategies and Management* 29(4): 723-740.

Breetzke, G. D. (2018) The concentration of urban crime in space by race: Evidence from South Africa. *Urban Geography* 39(8): 1195-1220.

Breetzke, G. D. and Edelstein, I. S. (2019) The spatial concentration of crime in a South African township. *Security Journal* 32(1): 63-78.

Breetzke, G. D., Fabris-Rotelli, I., Modiba, J. and Edelstein, I. (in press) The proximity of sexual violence to schools: Evidence from a township in South Africa. *GeoJournal* doi: 10.1007/s10708-019-10093-3.

Britt, H., Carlin, B. and Toomey, T. (2005) Neighborhood level spatial analysis of the relationship between alcohol outlet density and criminal violence. *Environmental and Ecological Statistics* 12(4): 411-26.

Ceccato, V. and Newton, A. (2015) *Safety and Security in Transit Environments: An Interdisciplinary Approach*. Basingstoke: Palgrave.

Clarke, R. V. (1999) Hot products: Understanding, anticipating and reducing demand for stolen goods. Police Research Series, Paper 112. London: Home Office.

Cohen, L. and Felson, M. (1979) Social change and crime rate trends: A routine activity approach. *American Sociological Review* 44(4): 588-608.

Conrow, L., Aldstadt, J. and Mendoza, N. S. (2015) A spatio-temporal analysis of on-premises alcohol outlets and violent crime events in Buffalo, NY. *Applied Geography* 58: 198-205.

Crime Hub. (2018) Institute for Security Studies Crime Hub. https://issafrica.org/crimehub, accessed 2 February 2020.

CrimeStats (2019) Crime Stats Simplified. http://www.crimestatssa.com/topten.php, accessed 2 February 2020.

Daniel, L. (2018) City of Cape Town: Declare 'state of emergency' over railway attacks. https://www.thesouthafrican.com/news/cape-town-state-of-emergency-metorail-trains/, accessed 2 February 2020.

Day, P., Breetzke, G. D., Kingham, S. and Campbell, M. (2012) Close proximity to alcohol outlets is associated with increased serious violent crime in New Zealand. *Australian and New Zealand Journal of Public Health* 36(1): 44-50.

Dordley, L. (2018) MEC threatens to shut down taxi ranks amid violence. https://www.capetownetc.com/news/mec-threatens-shut-taxi-ranks-amid-violence/, accessed 2 February 2020.

Drawve, G., Moak, S. C. and Berthelot, E. R. (2016) Predictability of gun crimes: A comparison of hot spot and risk terrain modelling techniques. *Policing and Society* 26: 312-331.

Eck, J. E., Clarke, R. V. and Guerette, R. T. (2007) Risky facilities: Crime concentration in homogeneous sets of facilities. *Crime Prevention Studies* 21: 225–264.

Edelstein, I. and Arnott, R. (2019) Point-level analysis of crime in Khayelitsha: A critical review. https://www.africaportal.org/publications/point-level-analysis-crime-khayelitsha-critical-review/, accessed 2 February 2020.

Freisthler, B., Midanik, L. and Gruenewald, P. (2004) Alcohol outlets and child physical abuse and neglect: Applying routine activities theory to the study of child maltreatment. *Journal of Studies on Alcohol and Drugs* 65(5): 586-92.

Gallison, J. K. and Andresen, M. A. (2017) Crime and public transportation: A case study of Ottawa's O-train system. *Canadian Journal of Criminology and Criminal Justice* 59(1): 94-122.

Gorman, D. M., Speer, P. W., Gruenewald, P. J. and Labouvie, E. W. (2001) Spatial

dynamics of alcohol availability, neighborhood structure and violent crime. *Journal of Studies on Alcohol* 62: 628–36.

Groff, E. R. and McCord, E. S. (2012) The role of neighborhood parks as crime generators. *Security Journal* 25(1): 1-24.

Groff, E. R. and Lockwood, B. (2014). Criminogenic facilities and crime across street

segments in Philadelphia: Uncovering evidence about the spatial extent of facility influence. *Journal of Research in Crime and Delinquency* 51(3): 277-314.

Hewitt, A., Beauregard, E., Andresen, M. A. and Brantingham, P. L. (2018) Identifying the

nature of risky places for sexual crime: The applicability of crime pattern and social disorganization theories in a Canadian context. *Journal of Criminal Justice* 57: 35-46.

Hiropolous, A. and Porter, J. (2014) Visualising property crime in Gauteng. *South African Crime Quarterly* 47: 17-28.

Irvin-Erickson, Y. and La Vigne, N. (2015) A spatio-temporal analysis of crime at

Washington, DC metro rail: Stations' crime-generating and crime attracting characteristics as transportation nodes and places. *Crime Science* 4: 1-13.

Kautt, P. M. and Roncek, D. W. (2007) Schools as criminal "hot spots": Primary, secondary, and beyond. *Criminal Justice Review* 32(4): 339–357.

Kinney, B. J., Brantingham, P. L., Wuschke, K., Kirk, M. G. and Brantingham, P. J. (2008)

Crime attractors, generators and detractors: Land use and urban crime opportunities. *Built Environment* 34(1): 62–74.

Knutsson , J . (1997) Restoring public order in a city park . In: R. Homel (Ed.) *Policing for*

*Prevention: Reducing Crime, Public Intoxication and Injury* , Vol. 7. Monsey, NY: Criminal Justice Press, pp. 133 – 151 .

Kurland, J., Johnson, S. D. and Tilley, N. (2014) Offences around stadiums: A natural experiment on crime attraction and generation. *Journal of Research in Crime and Delinquency* 51(1): 5-28.

Kynoch, G. (2003) Friend or foe? A worldview of community-police relations in Gauteng townships. *Canadian Journal of African Studies* 37(2): 298-327.

Kynoch, G. (2005) Crime, conflict and politics in transition-era South Africa. *African Affairs* 104(416): 493-514.

Lemieux, A. M. and Felson, M. (2012) Risk of violent crime victimization during major daily activities. *Violence and Victims* 27(5): 635–655.

Malleson, N. and Andresen, M. A. (2016) Exploring the impact of ambient population measures on London crime hotspots. *Journal of Criminal Justice* 46: 52-63.

Matzopoulos, R., Berens, C., Bowman, B., Bloch, K., Langa, M., Kotze, E., Lloyd, S., Makanga, P. T., Mureithi, L. and Schuurman, N. (2017) *A mixed methods study of the nature and extent of the alcohol trade in Khayelitsha -and community perceptions.* Cape Town: Department of Community Safety.

McCord, E. S. and Ratcliffe, J. H. (2009) Intensity value analysis and the criminogenic effects of land use features on local crime patterns. *Crime Patterns and Analysis* 2(1): 17-30.

McCord, E. S. and Tewksbury, R. (2013) Does the presence of sexually-oriented businesses relate to increased levels of crime? An examination using spatial analyses. *Crime and Delinquency* 59(7): 1108-1125.

McCord, E. S., Ratcliffe, J. H., Garcia, M. and Taylor, R. B. (2007) Non-residential crime attractors and generators elevate perceived neighbourhood crime and incivilities. *Journal of Research in Crime and Delinquency* 44(3): 295–320.

Murray, R. K. and Swatt, M. L. (2013) Disaggregating the relationship between schools and

  crime: A spatial analysis. *Crime & Delinquency* 59(2): 163–190.

Nelson, A., L., Bromley, R. D. F. and Thomas, C. J. (2001) Identifying micro-spatial and

  temporal patterns of violent crime and disorder in the British city centre. *Applied*

  *Geography* 21(3): 249-274.

Newton, A., Partridge, H. and Gill, A. (2014) In and around: Identifying predictors of theft

  within and near to major mass underground transit systems. *Security Journal* 27(2):

  132-146.

Osborne, D., McCord, E. S. and Higgins, G. E. (2016) The interactive influence of prosocial

  places, youth population, and poverty on incidents of violent assault. *Deviant*

  *Behavior* 37(4): 385-400.

Page, O. (2001) Crime and crime prevention on public transport–reducing crime on public

  transport in South Africa appropriateness of crime prevention strategies. Paper

  presented at the 20th South African Transport Conference "Meeting the Transport

  Challenges in South Africa"- 16th-20th July, South Africa.

Payne, S. (2019) Cape Town Prasa attack: Arrest of teens welcomed, but parties call for

  full investigation. https://www.dailymaverick.co.za/article/2019-12-13-cape-town-

  prasa-attack-arrest-of-teens-welcomed-but-parties-call-for-full-investigation/,

  Accessed date: 4 February 2020, accessed 2 February 2020.

Pridemore, W. A. and Grubesic, T. H. (2013) Alcohol outlets and community levels of

  interpersonal violence: Spatial density, outlet type, and seriousness of assault. *Journal*

  *of Research in Crime and Delinquency* 50(1): 132-159.

Roman, C. G. (2002) Schools as generators of crime: Routine activities and the sociology of

  place. Unpublished PhD dissertation, American University, Department of Sociology.

Roncek, D. W. and LoBosco, A. (1983) The effect of high schools on crime in the
neighborhood. *Social Science Quarterly* 64: 598–613.

Roncek, D. W. and Faggiani, D. (1985) High schools and crime: A replication. *Sociological Quarterly* 26: 491–505.

Schwabe, C.A. (2000) Towards the development of a spatial information system for crime analysis and prevention: Some conceptual requirements and empirical evidence from South Africa. Unpublished research report for the South African Department of Arts, Culture, Science and Technology (DACST), Pretoria.

Scribner, R. A., MacKinnon, D. P. and Dwyer, J. H. (1995) The risk of assaultive violence and alcohol availability in Los Angeles County. *American Journal of Public Health* 85(3): 335-340.

Simons, A., Koekemoer, K., Niekerk, A.V. and Govender, R. (2018) Parental supervision and discomfort with children walking to school in low-income communities in Cape Town, South Africa. *Traffic Injury Prevention* 19(4): 391-398.

Smith, D. M. (1982). *Living under Apartheid*. London: Allen and Unwin.

Speer, P. W., Gorman, D. M., Labouvie, E. W. and Ontkush, M. J. (1998) Violent crime and alcohol availability: relationships in an urban community. *Journal of Public Health Policy* 19(3): 303-318.

South African Police Services (SAPS). (2019) Crime Statistics: Integrity. https://www.saps.gov.za/services/crimestats.php, accessed 2 February 2020.

Sherman, L.W., Gartin, P. R. and Buerger, M. E. (1989). Hot spots of predatory crime: Routine activities and the criminology of place. *Criminology* 27(1): 27–55.

Statistics South Africa. (2011) http://www.statssa.gov.za/?s=Khayelitsha, accessed 2 February 2020.

Weisburd, D., Groff, E. R. and Yang, S-M. (2012). *The Criminology of Place: Street Segments and our Understanding of the Crime Problem*. New York: Oxford University Press.

Wellsmith, M. and Burrell, A. (2005) The influence of purchase price and ownership levels on theft targets: The example of domestic burglary. *British Journal of Criminology* 45:741-64.

World Economic Forum. (2016). These are the world's five biggest slums. https://www.weforum.org/agenda/2016/10/these-are-the-worlds-five-biggest-slums/, accessed 2 February 2020.

Zhu, L., Gorman, D. M. and Horel, S. (2004) Alcohol outlet density and violence: A geospatial analysis. *Alcohol and Alcoholism* 39(4): 369-375.