

**A cross-national spatial study of crime using variables informed by the International  
Organization for Standardization (ISO)**

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## Abstract

Cross-national spatial studies of crime are rare. Reasons are manifold but include the lack of standardization of variables across, often diverse, contexts. In this study we propose a potential solution to this impasse by examining the spatial causes of violent crime across two axiomatically different contexts: Khayelitsha (in South Africa) and Fort Lauderdale (in the United States). In a departure from previous research our variable selection for this study is guided by the Organization for Standardization (ISO) standards, specifically ISO 37210 indicators – which relate to the *Sustainable Development of Communities*. We use these standards to operationalize the seminal spatial theory of crime, namely the social disorganization theory. Results show some similarity in the spatial risk factors associated with violent crime. We conclude by arguing for the benefits of using standardized variables in cross-national spatial crime research but also highlight the challenges of such an approach.

**Keywords:** standardization; International Organization for Standardization; South Africa; social disorganization

## Introduction

The social disorganization theory of Shaw and McKay (1942) is arguably the key theory of crime and place with a number of researchers having tested its applicability across a wide range of contexts (Andresen, 2006; Bellair & Browning, 2010; Breetzke, 2010; da Silva, 2014; Kingston et al., 2009; Strom & MacDonald, 2007). There are however numerous inconsistencies in the operationalization of the theory with researchers using a plethora of different variables (and/or combination of variables) to represent the four central tenets of the theory namely socio-economic deprivation, family disruption, residential mobility and ethnic/racial heterogeneity. For example, residential mobility has been measured as the

percentage renting (Law & Quick, 2013), the percentage that own their home (Martinez et al., 2010; Mazerolle et al., 2010) or based on the length of residence in the same house for a period of time, usually over five years (Law & Quick, 2013; Martinez et al., 2010; Roh & Choo, 2008; Sun et al., 2004). Likewise, family disruption has been defined as the percentage female-headed households (Lanier & Huff-Corzine, 2006; Roh & Choo, 2008; Strom & MacDonald, 2007), the percentage of single-parent households (Law & Quick, 2013; Wong, 2011), or the percentage divorced and/or separated parents (Beaulieu & Messner, 2010; Lowenkamp et al., 2003; Porter & Purser, 2010), among numerous others.

The non-standardized way in which the central tenets of the social disorganization theory have been operationalized is problematic as it limits the ability of spatial crime researchers to compare and benchmark their results with other, particularly international, studies. This is notably relevant to scholars undertaking spatial crime research in a developing context who would like to test the applicability of a ‘Western’ theory of crime in their own context and, in doing so, gain a more thorough theoretical understanding of crime and its underlying causes. The practical and policy implications of being able to suitably compare results across countries is also significant as many crime prevention strategies are informed by theory (see Akers, 1973; Brantingham & Brantingham, 1993; Wilson & Kelling, 1982). Given these concerns, several researchers have argued for the need of a more standardized, or uniform, approach when using ‘Western’ spatial crime theories as a guiding theoretical framework in their research (Breetzke, 2010; McCall & Nieuwbeerta, 2007; van Wilsem, 2004). One mechanism that allows for the standardization of variables used to operationalize spatial crime theories such as the social disorganization theory is the standards produced by the International Organization for Standardization (ISO). The ISO is a worldwide federation of national standards bodies that develop standards on a range of topics that are internationally agreed upon by experts in their field. In particular, the ISO 37120 indicators were specifically developed to assist in the

monitoring and evaluation of sustainable development initiatives pertaining to the environment and contain a number of standards that could potentially be used as proxies for the central tenets of social disorganization theory. Currently there are no existing international standardized measures allowing for spatial crime comparisons across differing contexts.

In this study we propose a potential solution to this problem by examining the causes of crime in two vastly different contexts: Khayelitsha (in South Africa) and Fort Lauderdale (in the United States) using variables informed by indicators developed by the ISO. In undertaking this analysis, a city in the Global South (Khayelitsha) can be compared to a city in the Global North (Fort Lauderdale) in terms of its crime causation, serving as an international benchmark against which to measure and compare broader levels of urban safety. To our knowledge, this is the first study of its kind to directly compare spatial crime patterns and their causes in cities in South Africa and the United States using a standardized approach.

### **The ISO and social disorganization**

Established in 1947, the International Organization for Standardization (ISO) is an independent and non-governmental organization whose mission is to develop international standards that can facilitate the exchange of goods and services among its 165-member countries. The ISO has published hundreds of standards over the past few decades on a diverse range of topics ranging from ISO1 which specifies the standard reference temperature for geometrical product specification and verification to ISO4921 which defines terms for basic knitting concepts. The ISO 37100 range of international standards in particular helps communities adopt strategies to become more sustainable and resilient. Among the series of standards within this sub-group is the ISO 37120, *Sustainable cities and communities– Indicators for city services and quality of life* standard, which outlines key measurements for evaluating a city's service delivery and quality of life. This series provides a list of standardized indicators and outlines a uniform approach on what to measure, and how to measure them in order for the indicators to be directly

comparable across cities and countries. The standards also provide guidance to cities on how to assess their performance towards contributing to the United Nations Sustainable Development Goals, the global roadmap for a more sustainable world. The ISO 37120 standards are structured around seventeen broad themes including the economy, education, energy, safety, shelter and services<sup>1</sup>. Within each broad theme there are several indicators for city performance which has been divided into core or required indicators, and supporting or recommended indicators, as well as profile indicators providing basic statistics and background information. Importantly, all indicators are clearly defined with specifications and guidelines given regarding their measurement and calculation. The indicators are not targets per se but rather the aim is that the application of these standards would promote simplified and inexpensive reporting which can be applied in cities, municipalities or local governments, irrespective of size, location or level of development. They also provide a standardized manner by which to measure performance and monitor progress over time, while promoting information sharing, transparency and open data. They offer the added benefit of contributing towards the creation of a reliable foundation of globally standardized data which can assist cities in building core knowledge, and can be used for comparative knowledge sharing.

There is considerable overlap between a number of ISO 37120 indicators and the social disorganization theory. In fact, the theory is based on the inherent notion that certain socio-structural characteristics of cities increase the risk of crime and delinquency in certain communities. Neighborhood characteristics related to socio-economic deprivation are particularly well represented amongst the ISO 37120 indicators although other neighborhood characteristics, specifically related to family disruption and residential mobility are, however, poorly represented. Despite these issues, there is still a substantial amount of overlap between certain tenets of social disorganization and the ISO indicators which serves as a good starting

point of creating a standardized variable dataset by which to measure and compare social disorganization across various locales.

Importantly, the use of standardized indicators to compare and contrast the performance of cities is not new. Several studies have examined the relevance of applying a variety of standards, including the ISO, to provide support for policy development and future planning (see Gonzalez-Garcia et al., 2019; Hong et al., 2019; Leonova et al., 2018). One notable example includes De Campos Filho et al. (2019) who used ISO 37120 indicators to compare the sustainability of four cities: Tbilisi (Georgia), Guadalajara (Mexico), Boston (USA) and London (UK). The researchers produced comparative sustainability scores on a range of measures in these cities which enabled city managers and other relevant stakeholders to benchmark and compare the position of their city globally in terms of its sustainability.

The plethora of ways in which the social disorganization theory can be operationalized can result in spurious results, and hinder attempts at comparative analysis. In terms of the former, a study by Groeneveld and Breetzke (in press) found a 20% difference in model performance when operationalizing the social disorganization theory using different sets of variables. Standardized indicators or variables have been used in a number of studies of sustainable development globally (Bortnik, 2019; De Campos Filho et al., 2019; Hong et al., 2019; Huovila et al., 2019; Leonova et al., 2018), yet no studies have attempted to examine their utility in spatial crime analysis. This study represents the first empirical attempt to use ISO indicators to compare and contrast the spatial risk factors for crime in two axiomatically different contexts.

## **Data and method**

### **Study areas**

The ‘township’<sup>2</sup> of Khayelitsha is located approximately 30 kilometers south-east of Cape Town in the southernmost tip of South Africa. The township was artificially established in 1983 under the directive of the former apartheid government of South Africa as a residential area for non-white residents. Similar to other previously segregated townships, Khayelitsha is located on the urban periphery and is (and continues to be) grossly under-serviced and under-resourced with very few recreational and green spaces, limited commercial and transport services, and sub-standard housing (Brunn & Wilson, 2013). Khayelitsha has a population of roughly 400,000 residents (Statistics South Africa, 2011) of which just under three-quarters live in severe poverty. In fact, according to the World Economic Forum (2016) Khayelitsha is one of the world’s five biggest slums together with cities in Kenya, India, Mexico and Pakistan. Crime is rampant with the township among the most violent in the country with a homicide rate consistently over 80 per 100,000 residents, almost double the national average (Crime Hub, 2018).

The city of Fort Lauderdale is situated on the south-east coast of Florida in the central region of Broward County, approximately 40 kilometers north of Miami. The study area comprises one of ten sub-counties within Broward county and has a population of roughly 300,000. This is about one sixth of the total population of Broward county which has an overall population of just under two million inhabitants. Similar to Khayelitsha, the city of Fort Lauderdale has higher levels of deprivation, and crime when compared to the national average (United States Census Bureau, 2018) although the city is nevertheless located in a highly developed state and country, when compared internationally.

## **Crime data**

Point-level crime data for Khayelitsha was obtained from the South African Police Service (SAPS). These data contain information pertaining to the location, date and time of occurrence of all crime in Khayelitsha from 2010 to 2012. Point-level crime data for Fort Lauderdale was obtained from the Fort Lauderdale Police Department for the period 2015 to 2018. According to the ISO 37120 guidelines violent crimes include offences that involve force or the threat of force to a person and are classified as one of the following four offences: murder and non-negligent manslaughter, rape, robbery and aggravated assault. The total violent crime reported rate is calculated as the total sum of these four categories per 100,000 population. Accordingly, these four crime categories were extracted from the two respective crime datasets and aggregated to a small area level (SAL) (in the case of Khayelitsha) and a block group (in the case of Fort Lauderdale) unit of analysis. A SAL is the smallest unit of analysis for which Statistics South Africa disseminates spatial information. There are 581 SALs in Khayelitsha with each SAL containing roughly 630 people. A block group is the smallest geographical level at which American Community Survey (ACS) data required for this study was available (United States Census, 2018). There are 197 block group areas in Fort Lauderdale sub-county with each block group having an average population of 1557 people. A three-year (2010-2012) and four-year (2015-2018) violent crime average was calculated for Khayelitsha and Fort Lauderdale respectively in order to compensate for possible temporal fluctuations, and to coincide with the respective census datasets available for each country. Ideally, we would have liked to have had crime data over the same time period but due to the non-alignment of available census data, this was not possible. The ISO-defined violent crime rate served as the dependent variable in our analysis for both study sites.



## **Census data**

A total of eight variables were extracted from Statistics South Africa's census of 2011 (<http://www.statssa.gov.za/>)<sup>3</sup> and the United States Census Bureau of 2018<sup>4</sup> to represent the tenets of social disorganization theory for Khayelitsha and Fort Lauderdale respectively. In six instances, variables were operationalized and calculated based on the ISO specifications, which allowed for a direct comparison of these two vastly different contexts. In two instances, it was simply not possible to use the ISO standards to represent a social disorganization concept as no loosely applicable indicator existed within the ISO 37120 indicators. In these instances, variables were extracted from both census datasets to represent a concept on the condition that their definitions, as specified in the respective census metadata of each country, were identical. Whilst we readily acknowledge that this may bring some uncertainty into the direct comparability of results for these two variables in particular, and to some extent the overall model performance, we believe that the benefit of a standardized comparison between the bulk of the indicators, outweighs the possible drawbacks. Besides, we are confident that the variables extracted for these two concepts are identical in their specification and interpretation.

*Socio-economic deprivation* was represented by five indicators: First, the 'Population living in poverty' ISO37120 indicator which is calculated as the number of people living below each country's respective poverty line divided by the total current population. The poverty line for each country for the applicable time period was obtained and the variable calculated per respective unit of analysis and expressed as a percentage. According to the ISO (2014), poverty is an indicator of social equity and reflects levels of economic and social marginality and/or inclusiveness of a city. Roughly 73% of the residents of Khayelitsha live below the poverty line whereas approximately 17% of the population in Fort Lauderdale live below the official poverty line. Second, the 'Unemployment' ISO 37120 indicator which is calculated as the number of working-age residents not in employment, divided by the total labor force and

expressed as a percentage. The labor force refers to the sum of the total persons employed and unemployed who are legally eligible to work. According to the ISO (2014) guidelines unemployment refers to individuals without work, actively seeking work in a recent past period and currently available for work. Third, the 'Population with no internet connection' ISO 37120 indicator which is calculated as the number of internet connections divided by the total population. This indicator provides a measure of social exclusion within societies most often as a result of geographic marginalisation, particularly in less developed contexts. Several authors have argued for the need to include measures related to geographic isolation and marginalization most often related to specific racial or ethnic groups in previous studies of social disorganization (Sampson & Wilson, 1995; Zahnow et al., 2013). Statistics South Africa (2011) includes data pertaining to access to the internet from home, a cell phone, work, an institution or elsewhere, and finally no access to the internet. Only 35% of households in Khayelitsha have access to the internet. Census data provided by the United States Census Bureau (2018) include households with internet subscriptions including dial-up alone, broadband such as cable, fiber optic, or DSL, satellite internet service and households without internet access. Roughly 13% of households in Fort Lauderdale do not have internet access. Fourth, the 'Population who do not own a motor vehicle' ISO 37120 indicator which refers to the percentage of the population who do not own a personal motor vehicle. The indicator is calculated as the total number of registered personal motor vehicle divided by the total population and expressed as a percentage. The ownership of motor vehicles has been included in previous studies of social disorganization as a measure of deprivation (Kassahun, 2005), however it could also serve as a proxy for geographic isolation. Roughly 87% of residents of Khayelitsha do not own a motor vehicle compared to eight percent of households of Fort Lauderdale. Finally, the 'Population without electricity ISO 37120 indicator' was used as a measure of socio-economic deprivation. The variable is calculated as the number of persons

without a connection to the electrical supply system divided by the total population and expressed as a percentage. According to the ISO (2014) the percentage of residents with an electricity connection is an indicator of the provision of a basic urban service, which is of particular relevance to cities in less developed regions of the world. Statistics South Africa (2011) measures electricity as the type of energy used for cooking, heating and lighting and include electricity, gas, paraffin, wood, coal, animal dung, candles and solar. The type of energy used for cooking, heating and lighting has previously been used in studies of social disorganization in the developing world (Breetzke, 2010; de Melo et al., 2017). Data related to the type of heating fuel used in households in Fort Lauderdale include electricity, utility gas, bottled/tank/LP gas, fuel/oil/kerosene, coal, wood, solar energy, other fuel or no fuel (United States Census Bureau, 2018).

The ISO indicator for residential density was used as a measure of *Urbanization* in the study and is calculated as the total amount of households divided by the surface area. Shaw and McKay (1942) did not include urbanization in their initial articulation of the social disorganization theory but the concept was later added by Sampson and Groves (1989) who included urbanization as a structural measure of social disorganization in communities. The researchers argued that more urbanized communities have a decreased capacity for social control compared to more rural or sub-urban communities. As a result, residential density has frequently been used as a variable in social disorganization studies to explain crime rates (Bruinsma et al., 2013; da Silva, 2014; Escobar, 2012; McCall & Nieuwebeerta, 2007). Khayelitsha is extremely densely populated, with a mean population density of approximately 26,000/km<sup>2</sup>, comparable to the three most overcrowded cities in the world, namely Dhaka in Bangladesh (44,500 people per km<sup>2</sup>), Mumbai in India (31,700 people per km<sup>2</sup>) and Medellin in Colombia (19,700 people per km<sup>2</sup>) Fort Lauderdale has a much lower mean residential density of approximately 2,500 people per km<sup>2</sup>.

*Residential mobility* was measured using the percentage of households that are renting. There is no existing ISO indicator in this regard, but the variable was included because of the identical census definitions in both countries. Statistics South Africa (2011) captures data on the tenure status of households, including properties that are rented, owned or occupied rent-free, while data related to tenure status captured by the United States Census Bureau (2018) distinguishes between owner and renter occupied housing units. *Racial/ethnic heterogeneity* was measured using a language diversity index. Similar to the residential mobility concept, there was no suitable ISO indicator. Linguistic variability has previously been used as a proxy for neighborhood-level heterogeneity either directly (Varano et al., 2009; Wickes et al., 2013), or using a form of index to capture language diversity (Graif & Sampson, 2009; Zahnnow et al., 2013). Other common forms of heterogeneity were considered including variables related to race and cultural background but Khayelitsha in particular is remarkably homogenous in this regard with almost 98% of the population Black African. In this analysis a measure of language diversity was constructed using the Blau index. The Blau index is defined as:

$$1 - \sum p_i^2$$

where  $p$  is the proportion of members in a given category and  $i$  the number of different categories (languages). A perfectly homogeneous group would receive a score of 0 while a completely heterogeneous group would receive a score of 1. The Blau index has been successfully used to measure diversity in studies ranging from cultural diversity in management (Richard et al. 2004) to gender diversity in boardroom and firm performance (Joecks et al., 2013). While a number of variations to the index have been developed (see Solanas et al., 2012 for a summary), we felt using this seminal index would be most appropriate to the study.

Table 1 provides the descriptive statistics for the dependent and independent variables used in the study. A number of features are noteworthy. First, the results illustrate the highly deprived nature of Khayelitsha - certainly when compared to Fort Lauderdale - with all socio-

**Table 1:** Descriptive statistics of variables used in analysis

|                                      | Khayelitsha ( <i>n</i> = 581) |      |        |      | Fort Lauderdale ( <i>n</i> = 197) |      |      |      |
|--------------------------------------|-------------------------------|------|--------|------|-----------------------------------|------|------|------|
|                                      | Min                           | Mean | Max    | SD   | Min                               | Mean | Max  | SD   |
| Violent crime rate per 100,000 pop   | 0.0                           | 6.8  | 125    | 10.3 | 0.0                               | 5.2  | 69.7 | 9.2  |
| Socio-economic deprivation           |                               |      |        |      |                                   |      |      |      |
| % Population living in poverty       | 15.3                          | 73.3 | 99.3   | 15.6 | 0.01                              | 16.5 | 70.9 | 13.3 |
| % Unemployed                         | 0.0                           | 35.9 | 89.8   | 15.2 | 0.0                               | 7.8  | 41.1 | 7.1  |
| % Population with no Internet access | 1.0                           | 65.9 | 100    | 25.3 | 0.0                               | 13.2 | 46.5 | 10.3 |
| % Population with no motor vehicle   | 9.8                           | 86.3 | 100    | 12.4 | 0.0                               | 8.2  | 37.7 | 7.5  |
| % Population with no electricity     | 0.0                           | 39.3 | 100    | 25.7 | 0.0                               | 7.8  | 34.4 | 6.1  |
| Urbanization                         |                               |      |        |      |                                   |      |      |      |
| Population per km <sup>2</sup>       | 474                           | 8576 | 45 873 | 6232 | 128                               | 1074 | 7461 | 794  |
| Residential mobility                 |                               |      |        |      |                                   |      |      |      |
| % Households renting (non-ISO)       | 0                             | 11.6 | 100    | 13.1 | 0                                 | 45.3 | 100  | 24.3 |
| Ethnic/racial Heterogeneity          |                               |      |        |      |                                   |      |      |      |
| Language diversity Index (non-ISO)   | 0.0                           | 0.2  | 0.6    | 0.1  | 0                                 | 0.7  | 0.9  | 0.2  |

deprivation indicators substantially higher in the township. These findings indicate a deprived and densely populated location and suggest that the effects of apartheid's spatial planning policies could still be felt within certain regions of the city. Also notable is the considerably higher percentage of households renting in Fort Lauderdale compared to Khayelitsha (45 percent vs 12 percent) and the greater language diversity in Fort Lauderdale. Finally, the relatively large standard deviations across most variables suggest that scores are relatively widely dispersed and varied considerably, although less so in Fort Lauderdale.

Spearman's correlations between the variables used in the study are shown in Tables 2 and 3. Interestingly, only the percentage renting was found to be positively and significantly correlated with violent crime in Khayelitsha (see Table 2). Other significant relationships found were negative. Regarding the interrelationships between the independent variables themselves, the results were rather as expected with the percentage of residents living below the poverty line positively and significantly correlated with residents who do not have electricity and with areas of high residential density. Rather surprisingly however poverty was also found to be negatively correlated with the percentage renting. In Fort Lauderdale however, correlations were much more as expected with a number of variables positively and significantly correlated with violent crime including the population without a motor vehicle, population with no internet access and the population living below the poverty line (see Table 3). The population without a motor vehicle was also positively correlated with having no internet and the percentage renting. The correlations suggest that the social disorganization theory may play a more important role in explaining violent crime in Fort Lauderdale compared to Khayelitsha.

**Table 2:** Correlations for dependent and independent variables for Khayelitsha

|  | 1       | 2       | 3       | 4       | 5       | 6       | 7       | 8      | 9    |
|--|---------|---------|---------|---------|---------|---------|---------|--------|------|
| 1 Violent crime rate per 100,000 pop   | 1.00    |         |         |         |         |         |         |        |      |
| 2 % Population living in poverty       | -0.17** | 1.00    |         |         |         |         |         |        |      |
| 3 % Unemployed                         | -0.05   | 0.28**  | 1.00    |         |         |         |         |        |      |
| 4 % Population with no Internet access | -0.12*  | 0.35**  | 0.07    | 1.00    |         |         |         |        |      |
| 5 % Population with no motor vehicle   | -0.20** | 0.79**  | 0.21**  | 0.37**  | 1.00    |         |         |        |      |
| 6 % Population with no electricity     | -0.07   | 0.45**  | 0.20**  | 0.28**  | 0.43**  | 1.00    |         |        |      |
| 7 Population per km <sup>2</sup>       | -0.30** | 0.48**  | 0.06    | 0.26**  | 0.51**  | 0.20**  | 1.00    |        |      |
| 8 % Households renting                 | 0.16**  | -0.52** | -0.16** | -0.21** | -0.47** | -0.35** | -0.43** | 1.00   |      |
| 9 Language diversity index             | 0.11    | -0.33** | -0.17** | -0.13** | -0.31** | -0.19** | -0.27** | 0.36** | 1.00 |

\*  $p < 0.05$ ; \*\*  $p < 0.01$

**Table 3:** Correlations for dependent and independent variables for Fort Lauderdale

|  | 1      | 2      | 3      | 4       | 5      | 6     | 7    | 8    | 9    |
|--|--------|--------|--------|---------|--------|-------|------|------|------|
| 1 Violent crime rate per 100,000 pop   | 1.00   |        |        |         |        |       |      |      |      |
| 2 % Population living in poverty       | 0.30** | 1.00   |        |         |        |       |      |      |      |
| 3 % Unemployed                         | 0.15   | 0.39** | 1.00   |         |        |       |      |      |      |
| 4 % Population with no Internet access | 0.27** | 0.53** | 0.36** | 1.00    |        |       |      |      |      |
| 5 % Population with no motor vehicle   | 0.40** | 0.59** | 0.39** | 0.60**  | 1.00   |       |      |      |      |
| 6 % Population with no electricity     | 0.01   | -0.11  | -0.16  | -0.23** | -0.09  | 1.00  |      |      |      |
| 7 Population per km <sup>2</sup>       | -0.13  | -0.11  | -0.09  | -0.07   | -0.07  | -0.04 | 1.00 |      |      |
| 8 % Households renting                 | 0.35** | 0.52** | 0.20*  | 0.42**  | 0.50** | -0.17 | 0.06 | 1.00 |      |
| 9 Language diversity index             | -0.13  | -0.12  | -0.18* | -0.15   | -0.09  | 0.02  | 0.03 | 0.03 | 1.00 |

\*  $p < 0.05$ ; \*\*  $p < 0.01$

## Empirical analysis

A spatial error model was used in the analysis due to evidence of spatial dependence in the OLS model residuals (Moran's  $I$  values for Khayelitsha 0,126;  $p < 0.01$  and Fort Lauderdale 0,299;  $p < 0.01$ ). The general form of the spatial error model is:

$$y = X\beta + \varepsilon \text{ where } \varepsilon = \lambda W\varepsilon + \xi$$

Where  $\lambda$  is the spatial autocorrelation coefficient, while  $W\varepsilon$  is a spatially delayed error. This is interpreted as the mean error from neighbouring locations, while  $\xi$  is an independent model error. Spatial autocorrelation was modelled using first-order queens' contiguity. The results of the spatial regression models are presented in Table 4.

**Table 4:** Results of the spatial regression analyses

|                                      | Khayelitsha | Fort Lauderdale |
|--------------------------------------|-------------|-----------------|
| Error lag                            | 0.66***     | 0.76***         |
| Socio-economic deprivation           |             |                 |
| % Population living in poverty       | -           | -               |
| % Unemployed                         | -           | -               |
| % Population with no Internet access | -           | -               |
| % Population with no motor vehicle   | -           | -               |
| % Population with no electricity     | -           | 0.13*           |
| Urbanization                         |             |                 |
| Population per km <sup>2</sup>       | -1.76***    | -0.77***        |
| Residential mobility                 |             |                 |
| % Households renting (non-ISO)       | 0.22*       | 0.01***         |
| Ethnic/racial Heterogeneity          |             |                 |
| Language diversity Index (non-ISO)   | -           | -               |
| Pseudo $R^2$                         | 0.48        | 0.58            |

of interpretation, the non-significant coefficient results are excluded from the table.

NB: For ease

\*\*\* $p < 0.001$ ; \*\* $p < 0.01$ ; \* $p < 0.05$



Overall the results from the Fort Lauderdale study area were slightly more conventional in terms of expected outcomes with the model exhibiting a pseudo- $R^2$  of 58 percent compared to 48% for Khayelitsha. The percentage of the population living in poverty and the unemployment rate were notably non-significant in both models, while both have consistently been associated with higher levels of violent crime in both the developed and developing contexts (see Breetzke, 2010; Graif & Sampson, 2009; Jones-Webb & Wall, 2008; Swart et al., 2016). Interestingly, the variables that were significantly associated with violent crime were very similar in both contexts. In both the models the percentage of households that rent were positively significant. Residential density was also found to be highly significant in both models, but negatively so. The percentage of the population with no electricity was positively significant, but only in the Fort Lauderdale model. There was also strong spatial dependence shown in both models ( $p < 0.01$ ).

### **Discussion**

The aim of this study was to assess the utility of using ISO 37120 indicators in spatial crime research. This was done by using a selection of ISO indicators to test the applicability of the social disorganization theory to explain crime across two diverse contexts. Importantly, these indicators were calculated in exactly the same manner for both study areas in order to directly compare results. The calculation of the dependent variable as well as six of the eight independent variables were based on the strict ISO guidelines. The two variables not informed by the guidelines (i.e., the percentage renting and the language diversity index) were included in order to provide a more complete dataset although they could potentially be excluded if strict adherence is required.

The same variables in both models were found to be significant (the percentage renting (positive) and population density (negative)) with the latter in the opposite direction than what

was expected. Tenure status has consistently been found to be a strong predictor of violent crime in both developed and developing world contexts (Breetzke, 2018; de Melo et al., 2017; He et al., 2017; Lancaster & Kam-man, 2016; Thompson & Gartner, 2014; Warner, 2014) and this was confirmed in our research. Ironically, this consistency is most likely due to the similar ways in which these two variables are defined and calculated across contexts. Explanations for these results are context-dependent. In Khayelitsha roughly 50% of households that are renting reside in informal dwellings or in shacks in the backyard of formal dwellings (Statistics South Africa, 2011). Informal backyard shacks represent South Africa's fastest growing housing subsector (Lategan et al., 2020; Turok & Borel-Saladin, 2016) having increased by over 55% over the past decade (Statistics South Africa, 2011). Informal backyard rental housing in Khayelitsha is typically located in more established older neighborhoods of townships where this informal service provides a source of income for poor homeowners acting as landlords (Shapurjee & Charlton, 2013). These backyard dwellers rely on formal services delivered to the main housing structure. Due to the fact that renters share the services with the landlord from whom they rent, service delivery (refuse removal, water supply, sanitation, electricity) is often overextended resulting in overused toilets and the informal tenants often accessing electricity illegally via informal connections (Gardner & Rubin, 2017; Lategan et al., 2020; Turok & Borel-Saladin, 2016). In this sense, this variable can be considered a strong proxy for extreme deprivation. Similarly, in Fort Lauderdale this variable could also be a proxy for deprivation. Over 45% of households rent in Fort Lauderdale, and of these, roughly 50% are cost-burdened (Housing and Community Development Division, 2020). Unlike in South Africa, however, these residents qualify for rental assistance from the government with several government initiatives addressing housing needs including the State Housing Initiatives Partnership (SHIP). This difference in social support could possibly be used to explain the

difference in strength in magnitude of the association found in this variable across both contexts.

Similar to tenure status, residential density was found to be significantly related to crime in both contexts but negatively so. A number of studies have previously found measures of residential density to be negatively associated with crime in both the developed and developing context (Bruinsma et al., 2013; Escobar, 2012; York Cornwell & Behler, 2015). Explanations for this finding are speculative but are, again, context-dependent. In terms of Khayelitsha, it could be that an increase in residential density may somehow strengthen social networks and concomitantly increase capable guardianship in the township. It could be that areas with high population density have a greater number of capable guardians with the ability to exercise informal social control and, thus, the opportunity for violence is greater elsewhere. In Fort Lauderdale this negative association could possibly be explained by the popular and densely populated oceanfront, where high-rise buildings are associated with expensive and luxurious accommodation. In Changchun, China Liu et al. (2016) also found residential density to be negatively associated with crime and explained this anomaly by highlighting the high density newly constructed and luxurious high-rise private property development characteristic of certain regions of the city.

### **The benefits of using standardized variables**

The ISO 37120 indicators used in this study provide the guidelines for creating standardized measurements of social disorganization which are directly comparable across space. Such standardizations are currently lacking in studies applying social disorganization theory across national and cross-national contexts. In order to gain a wider theoretical insight into, and make generalized assumptions about, socially disorganized communities in the developing context and the effects they have on crime levels, it is imperative to move beyond individual localities

at specific periods in time. If it is true that the same factors affect communities around the world in similar ways, it is important to seek that knowledge through comparative analyses. With the many measurable commonalities that exist across contexts, the creation of reliable foundations of globally standardized data can assist in the building of core knowledge around social disorganization and the root causes of crime, specifically in the developing context where it is so desperately needed. There are also a number of potential implications for following this course of action.

From a theoretical perspective, the use of ISO standards allows for the creation of robust predictors of crime causation across contexts that is feasible. A growing number of researchers from the developing world have already questioned the applicability of the social disorganization theory in their particular context due, in part, to the definition of variables (Arias & Barnes, 2017; Breetzke, 2010; Ceccato & Ceccato, 2017; Liu et al., 2016; Zhang et al., 2007). Several researchers have tested and adapted the theory in order to suit their unique local context, and have identified alternative predictor variables they deem ‘more appropriate’ to their context (Breetzke, 2010; de Melo et al., 2017; Escobar, 2012). Indeed, some measures used in these studies have been rather unorthodox but nevertheless relevant; for example the percentage of households with exclusive bathrooms in Brazil (de Melo et al., 2017) or the percentage child-headed households in South Africa (Swart et al., 2016). The results of their research have also shown how significant predictors of crime can vary depending on the local context whilst the meaning of variables can also alter depending on the context within which they are being measured. By adapting the social disorganization theory to suit a particular context, the applicability of the theory to explain crime becomes blurred. In contrast, by prescribing standardized variables to delineate the social disorganization theory in this study we have shown how this theory can be used to examine crime in one particular context, but also allow for a direct comparison with another. Indeed, the variables used in this study were

defined, measured, and calculated in exactly the same manner and were therefore directly comparable. This results in the creation of reliable and valid knowledge of crime across these two contexts that are consistent, accurate and systematic.

From a practical perspective, having a standardized set of knowledge that is internationally comparable and transferable allows for crime management interventions to be implemented based on one of most influential theories of crime and place. South Africa, in particular, is in dire need of strategies to help guide crime reduction, and ultimately, prevention initiatives. While several crime prevention policies have been developed in the country since democracy in 1994, there has often been a detachment between theory and the practical implementation of policy with too much emphasis placed on role players in the justice and security cluster, and little on addressing the issue of urban safety. The social disorganization theory focusses specifically on the extent to which community-level characteristics of neighborhoods increase the risk of crime. Numerous studies have shown the relevance and importance of understanding social disorganization and its association with crime in a local context, but there is also a need to generalize the findings of these studies beyond individual locations, specifically in the developing context. Although the management of crime and violence certainly requires knowing how, when and where it occurs, its reduction involves an explanation of why crime occurs, and tailoring responses accordingly (Faull, 2019). By being able to test the applicability of the social disorganization theory in a uniform and standardized way allows for the use of strategies that have been successful in other contexts to be possibly implemented in South Africa. For example, knowing that renting is a key risk factor for crime in both Fort Lauderdale *and* Khayelitsha (using a standardized approach) can allow key role players tasked with reducing crime in South Africa to use knowledge from US-based policing (and other) agencies to address this risk factor. South African role players can investigate how this issue is suitably managed and addressed in the US and use similar practical interventions

in Khayelitsha, where able, practical and appropriate. Moreover, knowledge regarding the root causes of crime can help prioritize these interventions and identify targets for programmes. It can also assist in focussed problem-orientated policing and limited resources being directed to areas where they are most needed and most likely to be effective. The SAPS are under immense pressure to combat the overwhelming scourge of crime in South Africa, and more so in the country's townships, like Khayelitsha, where crime is disproportionately concentrated. With mounting crime levels and pressure from the public to find solutions, any assistance to help reduce crime rates should be welcomed. Only by standardizing variables can the general relevance of the social disorganization theory and related implications for practical crime prevention policy be determined globally.

There are a number of limitations of this work that need to be considered. First, we readily acknowledge that this approach is not perfect. Certain key concepts of social disorganization such as family disruption and residential mobility are not appropriately 'captured' using any of the available ISO 37120 indicators. These indicators were originally developed to assist in the monitoring and evaluation of city services and quality of life and not to examine crime causation per se. Although certain variables defining socio-economic deprivation and urbanization are well represented others are not and this limits the ability of researchers to fully represent the social disorganization theory using this approach. New ISO indicators are however routinely developed and these could, in future, potentially be applicable. In fact, a new ISO 37123 *Sustainable cities and communities – Indicators for resilient cities* set of standards has recently been released that could be useful in this regard. Moreover, spatial crime researchers could also potentially choose their own unique ISO indicators or use another ISO standard altogether to compare crime across contexts, and not necessarily rely on a theory to guide variable selection. This data-driven approach would result in identical sets of standardized variables across any two contexts.

Second, it would have been preferable to examine spatial crime causation in Fort Lauderdale and Khayelitsha across the same time period, however data constraints limited this, notably the non-alignment of census dates. Census data for both countries are collected on a decennial basis, but in the US the data is updated through the American Community Survey (ACS) programme which provides additional annual estimates. The result is that the data used for Fort Lauderdale was more recent (2018) compared to the data used for Khayelitsha (2011). However, while the time periods used were different for the study areas, the crime data coincided with the census data for each study area respectively. This was preferable since the temporal alignment of crime data and socio-demographic data remains a major challenge of measuring social disorganization in the developing context (Breetzke, 2010; Ceccato et al., 2007; Escobar, 2012; Gaviria & Pagés, 2002; Yirmibesoglu & Ergun, 2007).

A final concern pertains to the integrity of the crime data in South Africa in particular. It is estimated that roughly 40% of crime in Khayelitsha goes unreported (O'Regan & Pikoli, 2014). Several reasons for under-reporting have been reported including a lack in confidence in the police who are largely perceived to be inefficient and corrupt (O'Regan & Pikoli, 2014). Other reasons include insufficient police resources to handle the work load (Freeman & McDonald, 2015), and informal policing structures and gangsterism further complicating formal policing (Stone & Howell, 2019; Super, 2016). The extensiveness of informal infrastructure also affects spatial data quality. This issue is particularly relevant in the more informal locations in Khayelitsha and are largely a result of incorrect geo-tagging of crime locations where no street addresses exist, and crimes are consequently mapped to adjacent locations with formal street addresses. It is acknowledged that both the underreporting and imprecise spatial recording of crime may have an influence on the output of the regression models used. While unfortunate, this data limitation is simply a reality in a number of less developed contexts. Besides, crime data obtained from the SAPS is the only official and

spatially replete data available in the country by which to conduct analysis. Of course, the under-reporting of crime is not a uniquely South African problem (see Jaitman & Anauati, 2020), neither is it necessarily ‘worse’ in less developed countries. In fact, Buil-Gil et al. (2021) found that the ‘dark figure’ of crime in the United Kingdom for example, was larger not only in areas that are deprived but *also* in wealthy areas, dispelling the notion that the under-reporting of crime is likely to be more prevalent in less developed contexts. Their research confirmed previous findings in the US from Baumer (2002) who showed that resident living in more deprived neighbourhoods, as well as those living in wealthy areas, are more likely to under-report crime.

These limitations notwithstanding, we believe that future cross-national spatial studies of crime should – where possible - use standardized variables to represent certain spatial crime theories as this would enable researchers to benchmark and compare their city globally in terms of their spatial crime risk factors. Of course, are not advocating for the substitution of existing ‘conventional’ variables in spatial crime research or in any study in which the social disorganization theory, or other spatial crime theory, are employed but rather motivate that standardized measures can, in certain instances, provide an extra string in the bow for researchers, particularly in contexts outside the West, to compare and contrast their results with their Western peers.

### **Notes**

1. The 17 categories include: economy, education, energy, environment, finance, fire and emergency response, governance, health, recreation, safety, shelter, solid waste, telecommunication and innovation, transportation, urban planning, waste water, water and sanitation. It was first published in 2014 and a revised version was released in July 2018 with addition of 28 new indicators, the removal of 24 old ones and a slight modification to 10 indicators.



2. A township is a remnant of the apartheid era. These were non-white neighborhoods that “developed as dormitory settlements without any substantial ‘urban’ elements, as witnessed by their rudimentary infrastructure (public services, recreation, industry, transport, green spaces)” (Jurgens et al., 2013, p.256). They most often lie on the periphery of most main urban centers in South Africa, distant and distinct from the former Whites-only urban core.
3. This is the most recent census data available.
4. The data used was extracted from the American Community Survey (ACS) which forms part of the US decennial census programme.

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