

EXPLORATORY SPATIAL DATA ANALYSIS (ESDA) OF VIOLENT, ECONOMIC AND SEXUAL OFFENDERS IN THE CITY OF TSHWANE, SOUTH AFRICA

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ABSTRACT

While local researchers postulate the proximate causes of crime, few spatial-ecological studies have been used to investigate the location of offenders. In this study, for the first time in a South African context, the spatial origin of offenders across three crime categories are investigated: violent, economic and sexual. The cause of these spatial patterns of offenders within the City of Tshwane Metropolitan Municipality (CTMM) are examined using variables and indices informed by common ecological theories of crime as input into a series of Ordinary Least Squares (OLS) and Spatial Lag (SL) regressions. Comparisons of the log likelihood function measure across the models indicate a slightly better fit of the spatial lag specification to that of the OLS regression. The findings of the study indicate that the location of offenders within Tshwane appears to be associated with the spatial incidence of two broad factors – unemployment and high residential mobility. Results of this study not only reveal interesting insights into the racially defined nature of South African society, but more importantly shows how the spatial origin of offenders are driven predominantly along racially defined regions within the CTMM. The highlighting of such ‘high offender’ areas as well as other factors such as the increasing incidences of black Africans in the media as criminal offenders, and the greater number of black Africans in prisons in South Africa, tend to reinforce the racially based stigma that is often attached to crime in the country. These traditionally black African suburbs are however, shown in the study to be among the poorest within the CTMM with high levels of unemployment and migration, a remnant of apartheid era policies of relocating non-whites from the traditional white suburbs into slums on the periphery of the city. A number of policy solutions are offered to reduce the amount of offenders emanating from specific regions within the Tshwane¹ municipality.

INTRODUCTION

Crime is crippling South Africa. Despite reservations regarding the reliability of police crime statistics in the thirteen years following apartheid (Altbeker 2005:8; Berg & Schärf 2004:57), it is generally acknowledged that crime levels in the country are high and continue to rise year-on-year across a number of crime categories (Berg & Schärf 2004:57). According to the latest crime statistics released by the South African Police Services (SAPS) in 2007, crimes such as murder, hijackings and house and business robberies are on the increase throughout the country. While official crime statistics for 2007 indicate that crime overall is on the decrease, serious and violent crimes continue to rise, with murder remaining particularly high at roughly 40 murders being committed per 100 000 population annually. These worrying trends have lead researchers in the past to label South Africa as a ‘post-conflict’ society (Schärf 2003:52) and question whether crime is a threat to national security (Hough 2003:188). In truth, the South African government has not been oblivious to the increasing

¹ The City of Tshwane Municipality is an amalgamation into one metropolitan council of the former municipalities of Akasia, Pretoria and Centurion.

crime levels with various policing strategies being put in place during this post-apartheid period to address the issue; these include the National Crime Prevention Strategy (NCPS) of 1996 and the National Crime Combating Strategy (NCCS) of 2000. Both strategies have received few plaudits however (Leggett, Louw, Schönreich & Sekhonyane 2003; Van der Spuy 2001), and the unwavering crime levels and heightened fear of crime among residents of the country according to Mistry (2004:17) spells an uncertain strategic future.

A need exists in South Africa to pursue geo-analytical investigations into aspects pertaining to crime, offenders and their spatial distribution. In doing so policymakers can gain a spatially-based perspective of the motivators driving criminal behaviour and integrate that knowledge into crime reduction initiatives. It has long been realised that criminal behaviour is influenced by geography. The spatial and ecological perspectives of crime are noted by Lowman (1986:81-91) who provided a detailed 150-year-old history of these perspectives, culminating in the emergence of environmental criminology in the 1970s. The theory of environmental criminology was developed primarily by two Canadian researchers, Patricia and Paul Brantingham (1981), who examined the influence that space and time have on crime. Traditionally, environmental criminology has examined the spatial distribution of offences, as well as the spatial distribution of offenders (Bottoms & Wiles 1994:586); both of which foreshadowed the advent of computerised crime mapping using Geographical Information Systems (GIS) (Schneider & Kitchen 2002:13). Internationally, GIS has been widely utilised to garner knowledge regarding crime trends as well as to supplement crime-fighting strategies (Ashby 2005; Ashby & Longley 2005; Bowers, Johnson & Hirshfield 2004; Hirshfield, Brown, & Todd 1995); locally however, the use of the technology to inform decision-making particularly in public sector policing is sorely lacking (Breetzke 2006:734). The potential for GIS to supplement policing in the country nevertheless exists through among others, modelling the spatial location of criminal offences and offenders.

This study attempts to model the spatial distribution of violent, economic and sexual offenders in the City of Tshwane, South Africa using a number of variables and indices informed by common international spatial theories of crime. The aim of the study is to examine the extent to which milieu-centred criminological theories explain the spatial variation of offenders within Tshwane. Considering that common criminological theories such as the social disorganisation theory and routine activities theory have never been employed to analyse crime geographies in South Africa, the author felt it was important to gauge the relevance of international spatial theories of crime within a local context. The subdivision of offenders according to crime category additionally allows for the exploration of possible alternate motivators driving different crime categories.

METHOD AND MATERIALS

Methods and procedures utilised in the study comprise three components: first, offender indices locating the area of residence of offenders were constructed at a suburb level of aggregation for three categories of criminal behaviour: violent, economic and sexual; second, five crime predictor variables were selected and two indices developed to represent a number of spatial theories of crime including the social disorganisation and routine activities theory. Third, these scores were introduced as input into a series of Ordinary Least Squares (OLS) and Spatial Lag (SL) regressions in order to determine the effect of each score on the each crime category, which

acted as the dependent variables. Discussions that follow refer to the suburb level of aggregation and not to infer to the level of the individual. The spatial analysis, mapping and modelling was conducted using the ArcGIS™ and GeoDa™ software utilities.

The dependent variable

The offender indices were constructed using the residential addresses of offenders as well as the crime type for which an offender is currently incarcerated. In instances where an offender was incarcerated for more than one type of crime, the crime for which he/she was serving the longest sentence was utilised in the analysis. This data was obtained during March 2006 from the management information systems (MIS) of the South African Department of Correctional Services (DCS) at five correctional centres within the CTMM: Pretoria Central Correctional Centre (consisting of Pretoria Medium and Pretoria Maximum), Pretoria Female Correctional Centre, Odi Correctional Centre and Atteridgeville Correctional Centre. A total of 1004 offenders (violent = 294; economic = 501; sexual = 209) residing within the 371 suburbs in the Tshwane municipality were obtained and aggregated at a suburb level. The indices are mapped in Figure 1 and following common practice are expressed in rates per 1000 population older than 18. Offender rates are classified in terms of their standard deviation from the mean rate with high rate areas being expressed as those suburbs with a rate in excess of one standard deviation above the mean rate for each crime category. The log-transformed indices were subsequently used as the dependent variables in the analysis.

The spatial distribution of violent offenders is highly concentrated in the northern regions of the municipality in the predominantly former African homeland settlements of Ga-Rankuwa and Winterveld. These areas occur on the periphery of the municipality are typically impoverished black African areas with poor service provision. Similar to the rate of violent offenders, the spatial distribution of economic offenders is again dominated by suburbs northern regions of Tshwane with a number of suburbs also exhibiting high values in the eastern black African settlements of Mamelodi and Mahube Valley. High sexual offender rates are again spatially clustered in the northern regions of the municipality with Hammanskraal typically experiencing high rates, coupled with one or two suburbs in and around the Pretoria Central Business District (CBD).

Figure 1: Mean violent offender rate per 1 000 population older than 18

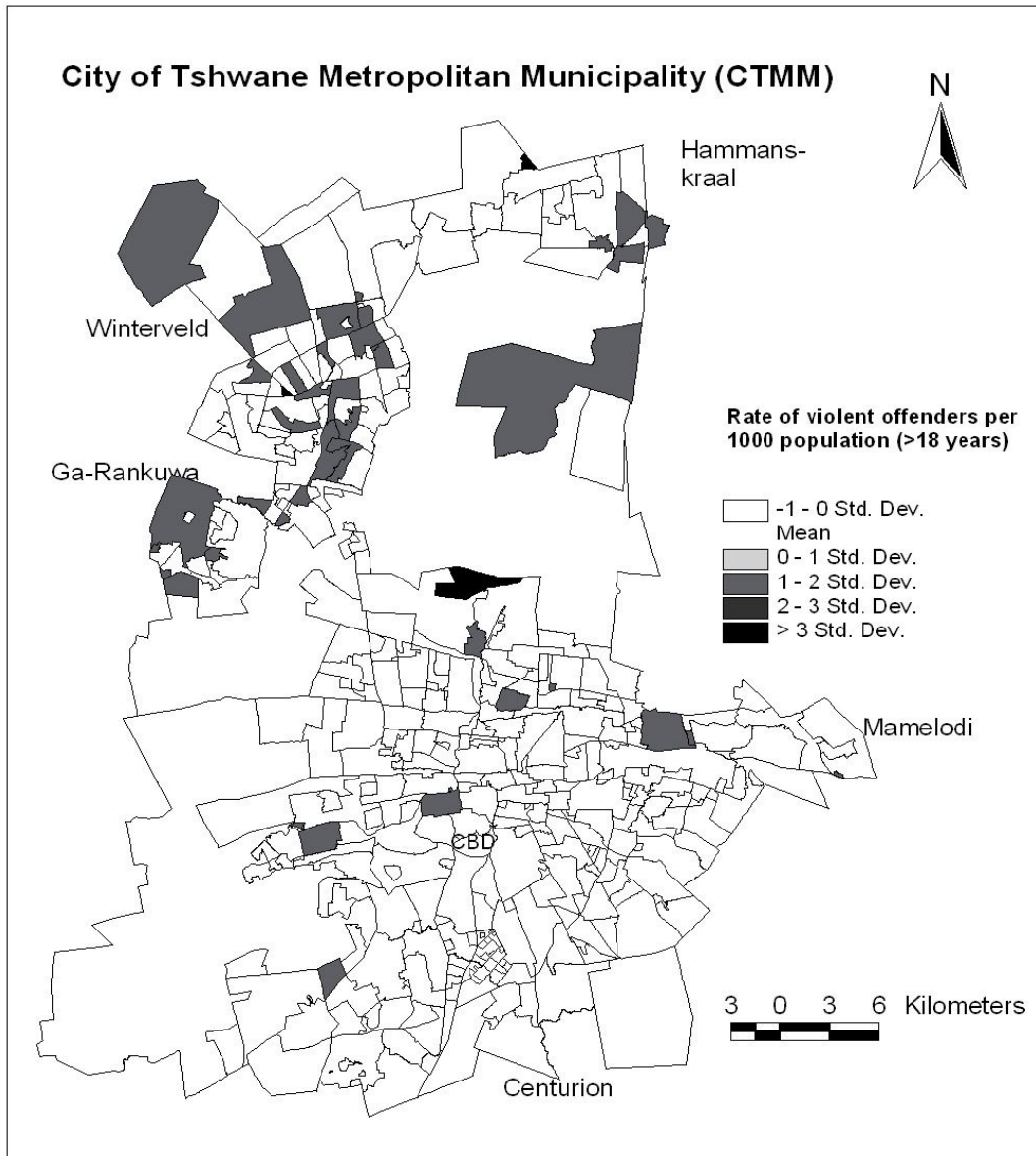


Figure 2: Mean economic offender rate per 1 000 population older than 18

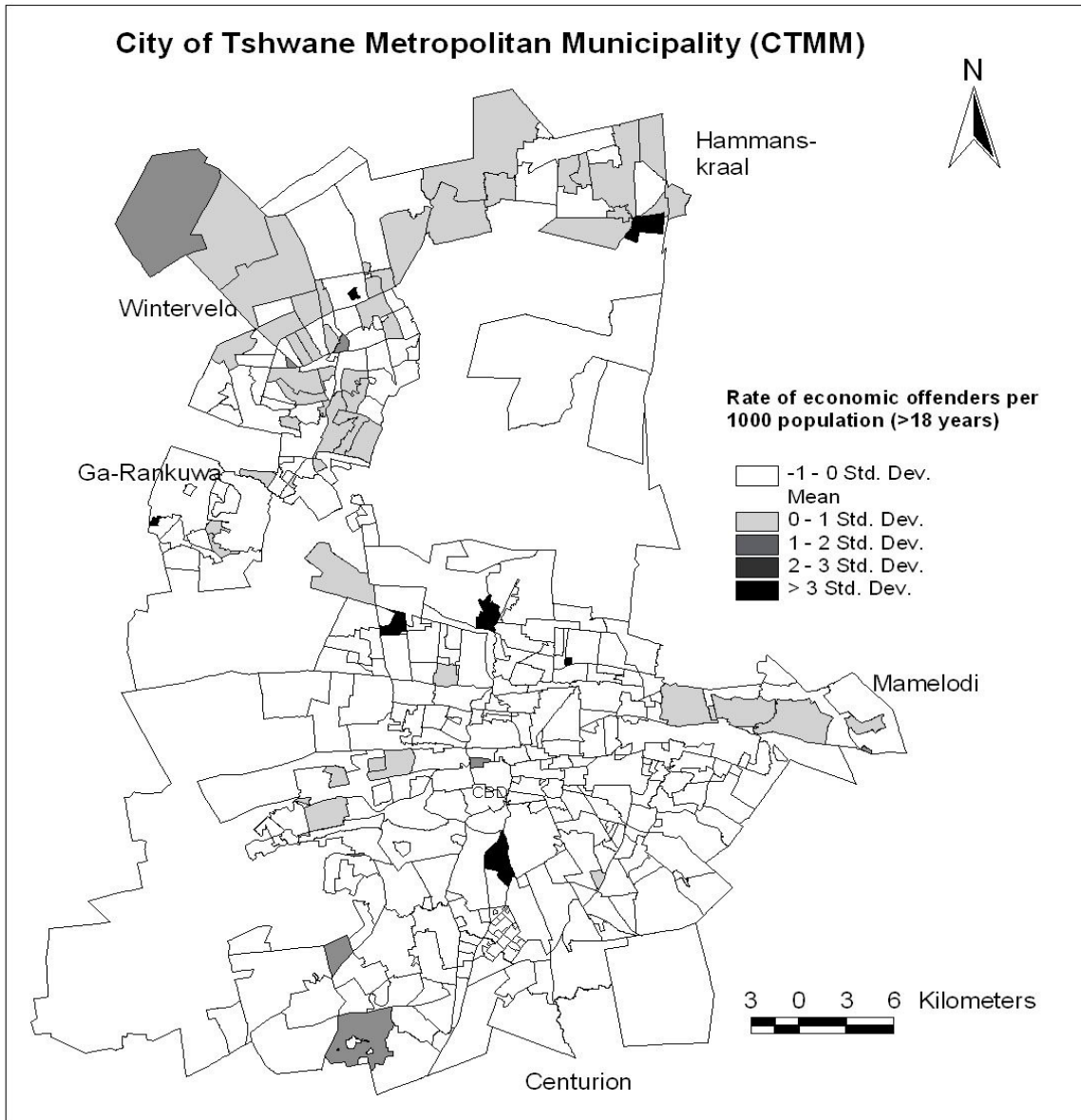
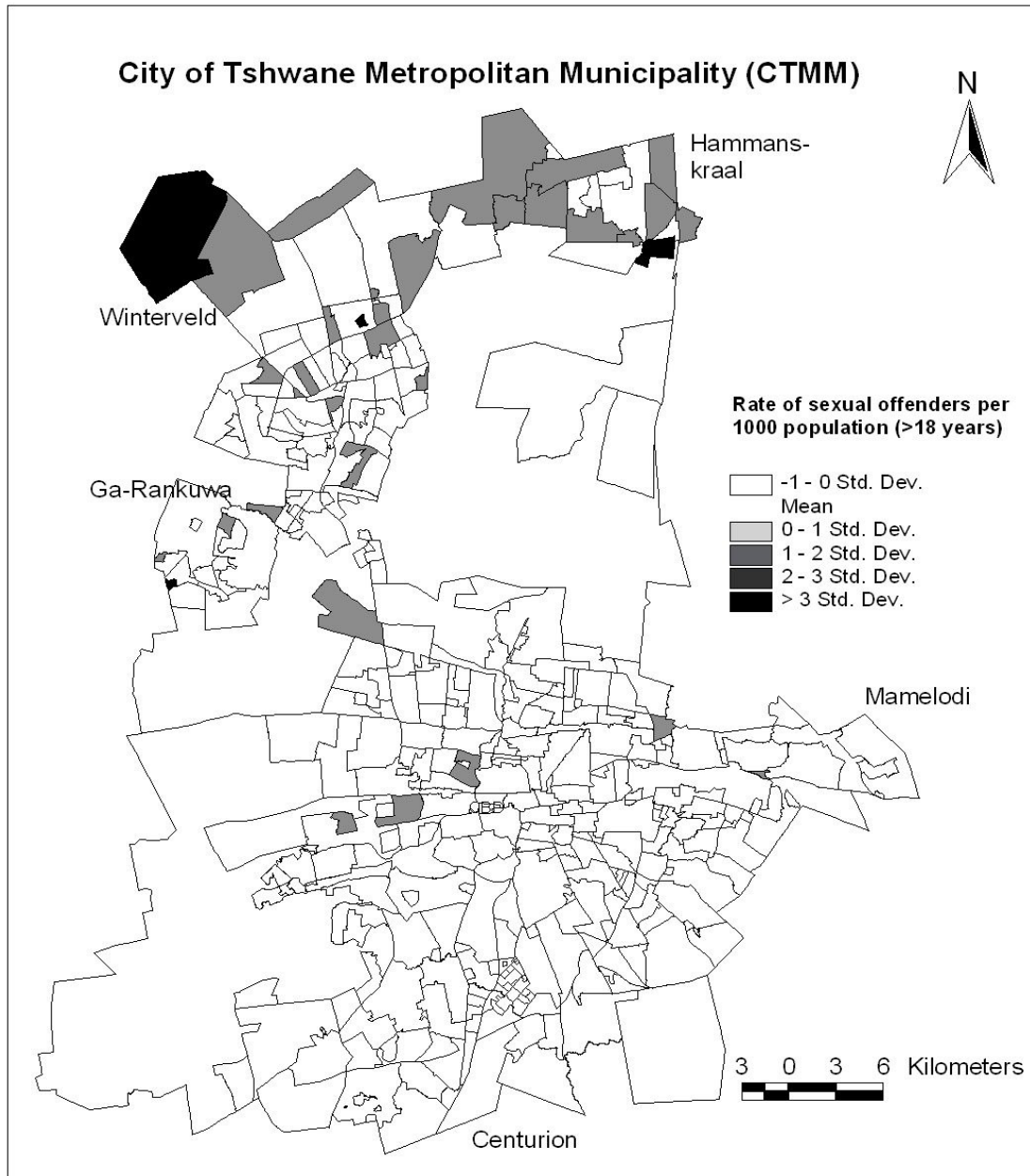


Figure 3: Mean sexual offender rate per 1 000 population older than 18



Selection of independent variables

The nature and causes of crime in South Africa are numerous and multifaceted (Maree & Prinsloo 2003:173; Schwabe, Schurink & Makakase 2000:12). Criminal offending is an abstract and multifaceted social phenomenon that cannot be expressed by a single variable. No single risk factor accounts for a high number of, for example, violent offenders emanating from a particular area as a variety of causal mechanisms can potentially operate upon an individual to motivate their behaviour. The variables that reflect possible motivators behind human behaviour are additionally manifested in a number of ways and may also not be evident in all people all the time. In international criminological literature three spatial theories of crime typically dominate: the social disorganisation theory (Shaw & McKay 1942), the routine activities theory (Cohen & Felson 1979) and the General Strain Theory (GST) (Agnew 1992). The social disorganisation and routine activities theories focus on issues of social and economic deprivation, ethnic heterogeneity, residential mobility and routine activities as predictors of the spatial patterns of crime (Andresen 2006:259), while according to the GST, individuals who experience strains or stressors are more likely to engage in crime than others who do not experience strain or stressors (Froggio & Agnew 2007:81). These three theories form the basis on which the independent variables were selected for the study. The socio-economic and demographic factors selected to represent these theoretical constructs were obtained from the Statistics South Africa (SSA) 2001 census dataset. While variables representing routine activities theory are generally obtained from victimisation studies, a number of researchers have successfully utilised census level data to represent some of the constructs (see Andresen 2006; Mustaine & Tewksbury 1998; Smith, Frazee & Davison 2000). As far as possible, single variables were used to represent each construct, however in instances where a number of variables exist for the representation of a single construct such as socio-economic deprivation, an index was developed using factor analytic techniques. Although criticised for being arbitrary and biased (Dohoo, Ducrot, Fourichon, Donald & Hurnik 1997:237), indices deal with the problem of multicollinearity of variables and additionally enable researchers to draw their own knowledge into their construction.

Socio-economic deprivation

A major focus of spatial theories of crime such as the social disorganisation and GST theory is the role of socio-economic disadvantage. To represent this construct two scores were selected, first, the percentage of individuals aged between 15 to 65 that are unemployed; and second, a multidimensional Basic Services Index (BSI). The BSI was based on the United Nations Development Programs (UNDP) parameters for deprivation in each of five dimensions: type of dwelling, source of water, toilet facilities, refuse or rubbish removal and energy or fuel for lighting, heating or cooking. The BSI provides a measure of service and social deprivation per suburb, the individual variables of which are highly correlated within the municipality. Exploratory factor analysis confirmed that the individual variables reflect the same underlying construct.

Residential mobility

To examine the role of mobility on offender rates, the variable 'percentage of resident that recently moved' (i.e. in the last five years) was included. In accordance with the social disorganisation theory, it is expected that high residential mobility will exhibit a positive relationship with all the offender rates.

Education

In this study, the lack of education is suggested as placing a strain on an individual that can lead to negative emotions, social strain and possibly result in criminal behaviour. The variable 'little or no education' is therefore included in the analysis. This is similar to previous criminological studies where the percent 'little or no education' variable is commonly used as a measure of strain (Agnew & White 1992; Landau 1997; Sharp, Terling-Watt, Atkins, Gilliam & Sanders 2001).

Age

A number of local researchers postulate a 'crime prone age' during which individuals are most likely to offend (Brown 2001:285; Masuku 2002:9; Maree 2003). In this study, independent of criminological theories, the percentage of individuals aged between 15 to 34 was included to assess the influence of age on the rates of offending within Tshwane.

Moral and social wellbeing

To assess the degree to which moral and social values influence the propensity of an individual to commit crime, a Moral and Social Wellbeing Index (MSWI) is included in the analysis. The MSWI is a factor-analysed summary measure based on five general indicators of morality and social wellbeing such as single-parent status, female-headed households, marital status and religious inclination. This index refers to the characteristics of the individual's social environment that overtly influences the extent of strain that he/she experiences in everyday life, thus aligning itself with the GST. Residing in a single-parent household, and/or having no religion inclination does not necessarily make you prone to offend but can create a more favourable environment for offending, or increase probabilities associated with risk factors (DiCristina 1995:77).

The operationalisations of the dependent and independent variables along with their means and standard deviation for the suburbs of Tshwane are presented in Table 1.

Table 1: Operationalisations and descriptive statistics of the dependent and independent variables for Tshwane

Variables	Operationalisation	Mean	Std dev.
Dependent variables			
Violent offender	Average rate of violent offenders per 1000 population ¹	0.13	0.29
Economic offender	Average rate of economic offenders per 1000 population ²	0.28	0.63
Sexual offender	Average rate of sexual offenders per 1000 population ³	0.12	0.32
Independent variables			
Socio-economic deprivation	% of suburb residents aged between 15-65 that are unemployed	13.99	13.97
	Index composed of the average z-scores of the following five variables:	15.51	27.31
	% of households that are classified as informal	17.21	27.48
	% of households with water outside their dwelling	21.81	35.23
	% of households with no flush toilets	19.72	34.33
	% of household with refuse not removed by authorities	20.58	29.23
	% of households with no electricity for lighting, heating or cooking		
Residential mobility	% of suburb residents that recently moved (i.e. in the last 5 years)	31.37	21.09
Education	% of suburb residents >20 with primary school or no education	19.97	18.08
Age	% of suburb residents aged between 15-34	38.34	11.92
Moral and social wellbeing	Index composed of the average z-scores of the following five variables:	31.45	10.75
	% of single parent households	32.25	12.07
	% of female-headed households	9.03	5.42
	% of suburb residents that are divorced, separated or living together	13.62	8.50
	% of suburb residents that have no religious inclination		

¹ Cross-sectional design, data obtained in March 2006

² Ibid.

³ Ibid.

Regression modelling of crime categories

The modelling of the five constructs occurred in two phases: initially, an Ordinary Least Squares (OLS) regression model was run on the dataset (see Table 2). Then a spatial lag variable (the measure of spatial association of offender rates in suburbs) was added and the regression repeated (see Table 3). Both models were then compared to determine whether the introduction of the spatially lagged variable improved the model's estimates.

In the OLS models of violent, economic and sexual crime, two independent variables: percentage unemployed and percentage recently moved appear highly significant ($p < 0.01$). This indicates that incidents of violent, economic and sexual offenders increase as unemployment and migration increases. All other variables were found to be not significant. The overall fit of the OLS models were not that impressive with an adjusted R^2 value of 0.165 for sexual offenders being the most encouraging followed by the violent (adjusted R^2 value of 0.130) and economic offenders (adjusted R^2 value of 0.066). According to Chainey and Ratcliffe (2005:134) traditional OLS regression has been brought into question by social scientists when using spatial data. The two main concerns being first, the inability of OLS to recognise that the influence of variables can change over space, and second, the model's assumption of independence within the spatial dataset (including census variables and the offender rates). The clear nodes of localised spatial autocorrelation within each crime category, identified with the aid of the global and local Moran's I statistics, lent support to the inclusion of a spatial lag term into the regression model. Spatial Lag Model's (SLM) correct for spatial autocorrelation by accounting for the spatial collinearity among observed values in adjacent locations (Portnov 2005:295). As a result, a series of SLMs were developed for each crime category across the municipality. The spatially lagged dependent variable for these models was the natural logarithm of the number of violent, economic and sexual offenders per 1000 population over the age of 18. The results are presented in Table 3.

An introduction of the spatial lag term in the analysis did not alter the regression estimates to any significant degree. Similarly to the OLS models of violent, economic and sexual crime, two predictor variables: percentage unemployed and percentage recently moved again appeared highly significant ($p < 0.01$). The influence of other variables was not significant. A comparison between the overall performances of each set of models is difficult since SLMs do not report an R^2 or an F-statistic and the adjusted R^2 of OLS and *pseudo* R^2 of SLM are not directly comparable (Anselin 2005:207). A subsidiary measure of comparability between the models' output does exist however, and is included in Tables 2 and 3 as the log likelihood function. This measure of model fit is based on the assumption of multivariate normality and the corresponding likelihood function for the standard regression model (Anselin 2005:175). A comparison of this measure indicates a slightly better fit of the spatial lag specification to that of the OLS regression. Comparisons of the log likelihood function for violent offenders in Table 3 shows an increase from -319.674 (for OLS) to -317.529 (for SLM), similarly for economic offenders that increased from -362.140 (for OLS) to -361.896 (for SLM) and sexual offenders which rose from -324.009 (for OLS) to -323.332 (for SLM). Differences between the log likelihood functions of the OLS and SLM are very marginal however and do not indicate any significant effect for the addition of the spatial effects variable. This conclusion is further validated when one compares the coefficients across both model types on all crime categories. The coefficients generally display a high degree of similarity i.e., for violent offenders in the OLS model the SDI

coefficient = -0.276, while in the SLM model the SDI coefficient = -0.274; similarly, for sexual offenders in the OLS model the percentage unemployed coefficient = -0.022, while in the SLM model the percentage unemployed coefficient = -0.021. This pattern continues across all crime categories for both models.

Table 2: OLS regressions of offender rates

Variable	(1)			(2)			(3)		
	<i>b</i>	<i>t value</i>	<i>Prob.</i>	<i>b</i>	<i>t value</i>	<i>Prob.</i>	<i>b</i>	<i>t value</i>	<i>Prob.</i>
Constant	0.048	0.294	0.768	0.018	0.102	0.918	0.196	1.171	0.242
Percentage informal	0.000	0.367	0.713	0.002	1.240	0.215	0.003	2.069	0.039
Percentage unemployed	-0.013	-3.753	0.000	-0.012	-3.188	0.001	-0.022	-6.146	0.000
Percentage males 15-34	-0.009	-1.945	0.052	-0.005	-1.016	0.310	-0.005	-1.213	0.225
Percentage recently moved (last 5 yrs)	0.007	4.249	0.000	0.006	3.078	0.002	0.005	2.923	0.003
Percentage little or no education	0.001	0.688	0.491	0.004	1.586	0.113	0.002	0.800	0.424
Service Delivery Index	-0.276	-1.669	0.095	-0.376	-2.022	0.043	-0.297	-1.770	0.077
Moral and social-wellbeing Index	0.033	1.009	0.313	0.000	0.017	0.986	0.016	0.494	0.621
Observations		371			371			371	
Adjusted R ²		0.130			0.066			0.165	
Log likelihood		-319.674			-362.140			-324.009	

Table 3: Spatial regressions of offender rates

Variable	(1)			(2)			(3)		
	<i>b</i>	<i>Z value</i>	<i>Prob.</i>	<i>b</i>	<i>Z value</i>	<i>Prob.</i>	<i>b</i>	<i>Z value</i>	<i>Prob.</i>
Spatial effect	0.160	2.226	0.025	-0.051	-0.646	0.518	0.086	1.181	0.237
Constant	0.071	0.435	0.662	0.016	0.089	0.928	0.206	1.245	0.212
Percentage informal	0.000	0.166	0.867	0.002	1.257	0.208	0.003	2.078	0.037
Percentage unemployed	-0.012	-3.456	0.000	-0.013	-3.276	0.001	-0.021	-6.011	0.000
Percentage males 15-34	-0.008	-1.829	0.067	-0.005	-1.077	0.281	-0.005	-1.192	0.233
Percentage recently moved (last 5 yrs)	0.007	4.073	0.000	0.006	3.159	0.001	0.004	2.736	0.006
Percentage little or no education	0.001	0.742	0.457	0.004	1.635	0.102	0.002	0.872	0.383
Service Delivery Index	-0.274	-1.684	0.092	-0.381	-2.077	0.037	-0.291	-1.761	0.078
Moral and social-wellbeing Index	0.026	0.819	0.412	0.000	0.014	0.988	0.010	0.312	0.754
Observations		371			371			371	
Pseudo R ²		0.161			0.085			0.185	
Log likelihood		-317.529			-361.896			-323.332	

DISCUSSION

In the study unemployment and migration were shown to be the most useful explanatory instruments to explain the cause of violent, economic and sexual criminal behaviour in the Tshwane municipality. These two criminogenic motivators are topically discussed below and this is followed by an examination of the possible relevance of each motivator to violent, economic and sexual criminal behaviour.

Crime motivators in the City of Tshwane: Unemployment and migration

The first main policy document to govern policing in post-apartheid South Africa, the NCPS (1996:18) in 1996 already identified 'historically shaped unemployment' as providing a ready recruitment ground for criminal activity and as contributing significantly to increased levels of crime in the country. In the eleven years since this statement was made the South African

economy has experienced positive year-on-year growth for ten consecutive years (Hesselink-Louw, Joubert & Maree 2003:93) yet according to the latest census statistics released by SSA in 2003 levels of unemployment rose almost 8% from 1996 to 2001. Unemployment in South Africa is additionally highly skewed with 41% of black Africans unemployed compared with only 6% of whites (Kingdon & Knight 2004:200), resulting in patterns of racial and spatial inequality linked to unemployment levels. In this context, being unemployed is defined in the October Household Survey (OHS) as those who want to work but did not look for work in the past four weeks.

There have been many reasons provided to explain the high rate of unemployment in the country. Researchers attribute the high rate of unemployment to among others, the prevailing education system (Mabunda 2002; Van der Linde 2000); the economic climate of the country (Cloete 2003); urban-rural income differentials (Asfaha & Jooste 2006), globalisation (Naude 2004) and the legacy of apartheid with associated social and economic implications (Blackmore 2003). Notwithstanding the possible reasons behind high unemployment levels, the identification of unemployment as a cause of crime in the municipality supports the social disorganisation theory as well as the strain theories of crime causation.

In South Africa, the assertion that addressing the issue of unemployment and associated socio-economic circumstances may lead to a reduction in criminal behaviour is not new. High levels of unemployment has been provided as being one of the main reasons behind farm attacks in the country (Swart 2003:42; Strydom & Schutte 2005:115), while Blackmore (2003:441) states that 49% of all offenders of physical, sexual and psychological abuse of women and girls in South Africa are unemployed. Brown (2001:294) found economic variables as being the most important determinants of crime in South Africa and Blackmore (2003:451), in a panel data analysis of crime in South Africa, highlighted unemployment as being one of the most significant explanatory variables of the high crime rate in the country. Other local researchers charge levels of unemployment coupled with high levels of inequality with the high crime rate in South Africa (Demombynes & Özler 2005:265; Hodgskiss 2004:91). In this study, unemployment is consistently shown to be a significant motivator behind offender rates. This has implications for future policing and policy formation.

The link between unemployment and inter- and intra-regional migration is well supported in South African literature (Cross, Kok, Wentzel, Tlabela, Weir-Smith & Mafukidze 2005; Pelser & De Kock 2000). Rapid growth in the South African economy has lead to increased job creation in urban settings and resulted in international and interregional migration. The Gauteng province, of which the Tshwane municipality forms part, is the preferred migration destination of migrants as a result of its superior service provision and wealth when compared to other provinces (Cross et al 2005:6). According to Oosthuizen and Naidoo (2004:6) the Tshwane municipality receives a relatively large proportion of non-Gauteng migrants (27.1 percent) compared to its share of the total provincial population (17.3 percent). It is also the predominately younger age group of people (18 to 30 years) and unemployed that first migrate into urban areas in South Africa (Cross et al 2005:25; Pelser & De Kock 2000:86). These young migrants often encounter urban unemployment and, with no social support system, could potentially become destitute and disillusioned. The subsequent lure of crime and gangsterism could therefore become too great to resist. The identification of high residential mobility as a cause of crime in the municipality

supports the social disorganisation theory where a premium is placed on mobility as being a driver behind crime causation. Overall however little support is found for the common international criminological theories in the Tshwane municipality. The positive relationship of the percent unemployed and percent recently moved with some of the models lends support for the social disorganisation and GST; however, the predominantly negative and statistically significant coefficients for the age, social/economic index, moral and social wellbeing index and education measures is counter to the expectations of most of the theories. A more detailed explanation of each category of offender follows.

Violent offenders

A culture of violence has been blamed for much of the violent crime occurring in South Africa (Maree & Prinsloo 2003; Masango 2004; Wedge, Boswell & Dissel 2000). Seen in this context, violent behaviour has been acculturated by formerly marginalised sectors of South African society through, amongst others, the political violence that abounded in the years preceding democracy. Children are coerced into a violent culture as they grow up in an environment in which violence becomes internalised and part of everyday living (Maree 2003:76). Factors like unemployment and migration, which were shown in this study to be positively related to violent offender rates, exacerbate the violent tendencies in individuals already frustrated and angry at the social and economic inequalities existing in South African society more than a decade after the end of apartheid.

Economic offenders

This study indicated a strong positive association between high rates of economic offending and levels of unemployment and migration. Locally, researchers obtain a strong positive association between levels of unemployment and crime (Blackmore 2003:451; Pelsler & De Kock 2000:86). A reduction in unemployment may not necessarily result in a reduction in organised crime however with Blackmore (2003:442) hypothesising that in South Africa organised crimes are motivated more by economic profits rather than greed. Unemployed individual offenders would be more motivated by need rather than greed and may be less motivated should their socio-economic grievances be met. These conclusions are supported by the study's results which indicated that unfavorable socio-economic circumstances, especially urban unemployment resulting from rapid urbanisation, might contribute to a continued increase in crimes motivated by economic need. A reduction in poverty and unemployment may also only lead to the displacement of economic crime from purely property crime to other forms of economic crimes such as white-collar and corporate crime.

Sexual offenders

Sexual offending has reached epidemic proportions in South Africa (Hesselink-Louw & Schoeman 2003:162) and is currently identified as a priority crime by the SAPS (NCPS 1996). The number of incarcerated sexual offenders in South African prisons has risen sharply in the preceding decade with Kriel (2005:108) reporting a 158% increase in sexual offenders from 1995 to 2003, and forecasting a further 90 percent growth in the sexual crime category by the

year 2013. Research on the etiology of sexual offenders worldwide is unclear despite increased knowledge and understanding in this field (Bergh 2006:2). While unemployment and migration may not directly lead to criminal sexual behaviour within the municipality but may act as contributing factors to the development of a low self-esteem, lack of assertiveness, anger and social incompetence, all of which have been identified by researchers as characteristic of sexual offenders (Blanchette 1996; Repp & Horner 1999).

CONCLUSION

The results of the study provide evidence for the racially defined inequalities that exist within the municipality as the majority of high rate suburbs clustered in the northern and western regions are representative of impoverished black African townships. These townships occur predominantly on the periphery of the municipality and have experienced explosive growth in recent years mainly from migrant labourers coming from other parts of the country or from other African countries. These traditionally black African townships are, however, also among the poorest within the municipality with high levels of unemployment and migration (Erasmus 2004:32; McIntyre Muirhead, Gilson, Govender, Mbatsha, Goudge, Wadee & Ntutela 2000:1-43), a remnant of apartheid-era policies of relocating non-whites from the traditional white suburbs into slums on the periphery of the city. What policy solutions can be offered to reduce the number of offenders emanating from specific regions within the Tshwane municipality? The results of this study suggest a reduction in unemployment and reduced migration would be beneficial. A number of developmental policy solutions have been put forth to curb unemployment and reduce migration including the South African government's macroeconomic strategy for growth, employment and redistribution (GEAR). Although initiatives such as GEAR should be applauded for attempting to address the social and economic inequalities in the country they tend to provide a more long-term solution to crime. Short-term solutions are however what is required in conjunction with longer-term goals. The often brutal and senseless nature of crimes in South Africa, between and within races and cultures, suggests angry and hate-filled individuals that have not been able to emerge from their past unscathed. This point is to some extent illustrated in the results of this study, which did not identify unique predictors per criminal behaviour within the municipality. Unemployment and migration were significant predictors across all crime categories but no other predictor was found to be significant at all. With the notable exception of the 'culture of violence' contention referred to earlier, this finding lends support to the generalised lack of understanding of the true motivations behind the ruthlessness of some criminal behaviour in the country.

From a theoretical perspective, little support is found for the application of the social disorganisation theory, routine activities theory, and general strain theory in a South African context, with only two constructs, percent unemployed, and percent recently moved as being significant, albeit significant in all models. Future research should focus on the development of a spatial theory of crime for South Africa. The rapid development of GIS and the large-scale production of population datasets necessitate the need for more aggregate level investigations into crime and its causes in the country.

REFERENCES

- Agnew, R. 1992. Foundation for a General Strain Theory of crime and delinquency. *Criminology*, 30: 47-87.
- Agnew, R. & White, H. R. 1992. An empirical test of General Strain Theory. *Criminology*, 30: 475-499.
- Allen, D. B. 2002. Race, crime and social exclusion: A qualitative study of white women's fear of crime in Johannesburg. *Urban Forum*, 13(3): 53-80.
- Altbeker, A. 2005. Positive trends: The 2004/5 crime statistics. *SA Crime Quarterly*, 14: 1-11.
- Andresen, M. A. 2006. Crime measures and the spatial analysis of criminal activity. *British Journal of Criminology*, 46: 258-285.
- Anselin, L. 2005. *Exploring spatial data with GeoDa™: A workbook*. University of Illinois: Spatial Analysis Laboratory.
- Asfaha, T. A. & Jooste, A. 2006. The agricultural input elasticity of rural-urban migration in South Africa. *Agrekon*, 45: 89-105.
- Ashby, D. I. 2005. Policing neighbourhoods: Exploring the geographies of crime, policing and performance assessment. *Policing and Society*, 15(4): 13-447.
- Ashby, D. I. & Longley, P. A. 2005. Geocomputation, geodemographics and resource allocation for local policing. *Transactions in GIS*, 9(1): 53-72.
- Berg, J. & Schärf, W. 2004. Crime statistics in South Africa 1994-2003. *South African Journal of Criminal Justice*, 17(1): 57-78.
- Bergh, L. B. 2006. Evaluation of a treatment programme for incarcerated rapists. Unpublished doctoral thesis, University of Pretoria.
- Blackmore, F. L. E. 2003. A panel data analysis of crime in South Africa. *South African Journal of Economic and Management Sciences*, 6(3): 439-458.
- Blanchette, K. 1996. *Sex Offender Assessment, Treatment and Recidivism: A Literature Review*. Canada: Correctional Services Research Division.
- Bottoms, A. & Wiles, P. 2002. *Environmental Criminology and Crime*. In Maguire, M., Morgan, R. & Reiner, R. (Eds). *The Oxford Handbook of Criminology* (3rd edition). UK: Oxford University Press.
- Bowers, K., Johnson, S. D. & Hirshfield, A. F. G. 2004. Closing off opportunities for crime: An evaluation of alley gating. *European Journal on Criminal Policy and Research*, 10(4), 285-308.
- Brantingham, P. J. & Brantingham, P. L. 1991. *Environmental Criminology*. Waveland: Prospect Heights.
- 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.
- Brown K. V. 2001. The determinants of crime in South Africa. *The South Africa Journal of Economics*, 69(2): 269-299.
- Chainey, S. & Ratcliffe, J. 2005. *GIS and Crime Mapping*. John Wiley & Sons: London.
- Cloete, C. 2003. Politicians are 'Smooth Talkers', *Diamond Fields Advertiser*, 11 June.
- Cohen, L. & Felson, M. 1979. Social change and crime rate trends: A routine activity approach. *American Sociological Review*, 44: 588-608.

- Cross, C., Kok, P., Wentzel, M., Tlabela, K., Weir-Smith, G. & Mafukidze, J. 2005. *Poverty pockets in Gauteng: How migration impacts poverty*. Pretoria: Human Sciences Research Council.
- Demombynes, G. & Özler, B. 2005. Crime and local inequality in South Africa. *Journal of Development Economics*, 76(2): 265-292.
- DiCristina B. 1995. *Method in criminology*. Harrow & Heston, New York.
- Dohoo, I. R., Ducrot, C., Fourichon, C., Donald, A. & Hurnik, D. 1997. An overview of techniques for dealing with large numbers of independent variables in epidemiologic studies. *Preventive Veterinary Medicine*, 29(3): 221-239.
- Erasmus J. C. 2004. *A development index for the City of Tshwane*. Pretoria: Human Sciences Research Council.
- Froggio, G. & Agnew, R. 2007. The relationship between crime and “objective” versus “subjective” strains. *Journal of Criminal Justice*, 35(2007): 81-87.
- Hesselink-Louw, A-N. E. & Schoeman, M. 2003. Treatment of incarcerated sex offenders in South Africa: An analytical perspective. *Acta Criminologica*, 16(1): 158-173.
- Hesselink-Louw, A-N. E., Joubert, S. & Maree, A. 2003. Criminological assessment of offenders: An analysis with the aim of promoting rehabilitation. *Acta Criminologica*, 16(5): 91-98.
- Hirshfield, A., Brown, P. & Todd, P. 1995. GIS and the analysis of spatially-referenced crime data: experiences in Merseyside, UK. *International Journal of Geographic Information Systems*, 9(2): 191-210.
- Hodgskiss, B. 2004. Lessons from serial murder in South Africa. *Journal of Investigative Psychology and Offender Profiling*, 1(1): 67-94.
- Hough, M. 2003. Crime in South Africa: Is it a threat to national security? In: Hough, M. & Du Plessis, A. (Eds). *Combating crime in South Africa: Contemporary perspectives*. Pretoria: Institute for Strategic Studies (ISSUP).
- Interdepartmental Strategy Team, 1996. *National Crime Prevention Strategy (NCPS)*. Pretoria: Government Printers.
- Kingdon, G. G. & Knight, J. 2004. Race and the incidence of unemployment in South Africa. *Review of Development Economics*, 8(3): 198-222.
- Kriel, J. 2005. Emerging trends among the South African inmate population and persons subject to community corrections. *Acta Criminologica*, 18(2): 100-115.
- Landau, S. F. 1997. Crime patterns and their relation to subjective social stress and support indicators: The role of gender. *Journal of Quantitative Criminology*, 13: 29–56.
- Leggett, T., Louw, A., Schönreich, M. & Sekhonyane, M. 2003. *Criminal Justice in Review 2001/2002*, Pretoria: Institute for Security Studies (ISS).
- Lowman, J. 1986. Conceptual issues in the geography of crime: Towards a geography of social control. *Annals of the Association of American Geographers*, 76: 81-94.
- Mabunda, N. P. 2002. The role of the school in preparing school leavers for self-employment. Unpublished doctoral thesis, University of South Africa.
- Maree, A. 2003. Criminogenic risk factors for youth offending. In: Bezuidenhout, C. & Joubert, S. (Eds). *Child and youth misbehaviour in South Africa: A holistic view*. Pretoria: Van Schaik.
- Maree, A. & Prinsloo, J. 2003. An exploration of crime and crime risks with specific reference to South Africa. In: Hough, M. & Du Plessis, A. (Eds). *Combating crime in South Africa: Contemporary perspectives*. Pretoria: Institute for Strategic Studies (ISS).

- Masango, M. J. 2004. Aggression, anger and violence in South Africa', *HTS: Theological Studies*, 60(3): 993-1006.
- Masuku, S. 2002. Prevention is better than cure: Addressing violent crime in South Africa. *SA Crime Quarterly*, 2: 5-12.
- McIntyre, D., Muirhead, D., Gilson, L., Govender, V., Mbatsha, S., Goudge, J., Wade, H. & Ntutela, P. 2000. *Geographic patterns of deprivation and health inequities in South Africa: Informing public resource allocation strategies*. Cape Town: Health Economics Unit and Centre for Health Policy.
- Mistry, D. 2004. 2003. National Victims of Crime Survey: Falling crime, rising fear. *SA Crime Quarterly*, 8: 17-24.
- Mustaine, E. E. & Tewksbury, R. 1998. Predicting risks of larceny theft victimization: a routine activity analysis using refined lifestyle measures. *Criminology* 36: 829–857.
- Naude, W. 2004. Post-apartheid South Africa in the world's economy: An assessment of inequality in an open developing country. *Africa Insight*, 34(4): 46-53.
- Oosthuizen, M. & Naidoo, P. 2004. *Internal migration to the Gauteng province*. Development Project Research Unit Working Paper 04/88. University of Cape Town: South Africa.
- Pelser, A. & De Kock, C. 2000. Violence in South Africa: A note on some trends in the 1990s. *Acta Criminologica*, 13(1): 80-94.
- Portnov, B. A. 2005. Development similarities in urban clusters: evidence from a spatial analysis of Israel's urban system. *Socio-Economic Planning Sciences*, 39(4): 287-306.
- Repp, A. C. & Horner, R. H. 1999. *Functional analysis of problem behaviour: From effective assessment to effective support*. Canada: Wadsworth.
- Schärf, W. 2003. *Themes emerging from the workshop discussions*. Insights from the Crime Prevention and Development Workshop of the Criminal Justice Initiative of the Open Foundation Society of South Africa, Stellenbosch, South Africa.
- Schneider, R.H. & Kitchen, T. 2002. *Planning for crime prevention: A transatlantic perspective*. New York: Routledge.
- Schwabe, C. A., Schurink, W. J. & Makakase, M. 2000. *Investigation into the most useful crime forecasting methodologies: Information required for strategic and operational crime forecasting*. Pretoria: Council for Scientific and Industrial Research (CSIR).
- Sharp, S. F., Terling-Watt, T. L., Atkins, L. A., Gilliam, J. T. & Sanders, A. 2001. Purging behavior in a sample of college females: A research note on general strain theory. *Deviant Behavior*, 22: 171–188.
- Shaw, C. & McKay H. D. 1942. *Juvenile delinquency and urban areas*. Chicago: University of Chicago Press.
- Smith, W. R., Frazee, S. G. & Davison, E. L. 2000. Furthering the integration of routine activity and social disorganization theories: Small units of analysis and the study of street robbery as a diffusion process. *Criminology*, 38: 489–523.
- Strydom, H. & Schutte, S. C. 2005. A theoretical perspective on farm attacks in the South African farming community. *Acta Criminologica*, 18(1): 115-125.
- Swart, D. 2003. Farm attacks in South Africa: Incidence and explanation. *Acta Criminologica*, 16(1): 40-44.
- Tshiwula, L. 1998. *Crime and delinquency*. Pretoria: Kagiso.
- Van der Linde, C. H. 2000. The need for relevant workforce education for the 21st century. *Education Chula*, 120: 696-702.

- Van der Spuy, E. 2001. *Crime and its discontent: Recent South African responses and policies*. Johannesburg: South African Institute of International Affairs
- Wedge, P., Boswell, G. & Dissel, A. 2000. Violence in South Africa: Key factors in the background of young serious offenders. *Acta Criminologica*, 13(2): 31-38.