CHAPTER 5

139

CROSSING THE RACIAL DIVIDE: A SPATIAL-ECOLOGICAL

PERSPECTIVE OF OFFENDERS IN THE CITY OF TSHWANE

METROPOLITAN MUNICIPALITY, SOUTH AFRICA

Gregory Dennis Breetzke and Andre Carl Horn

ABSTRACT

Post-apartheid South Africa has been plagued by an increase in crime and a concomitant increase in the number of incarcerated offenders. Researchers have postulated many proximate causes for the insidious increase in crime, including the vast socio-economic inequalities existing in the country, a remnant of apartheid-era policies and post-apartheid migrations. This article focuses on the neglected field of the environmental criminology of offenders. Following a spatial-ecological approach the relationship between various socio-economic variables and offender rates in the City of Tshwane Metropolitan Municipality in South Africa is modelled. The GIS-based methodological procedure includes a crime offender index (COI), correlational analysis (CA), and principal components analysis (PCA) and produced five factors: social status and income, family characteristics, unskilled earner, residential mobility and ageing population. These five factors, accounted for almost 75 percent of the variance in the offender index. The findings of our research reject race as a determinant of crime, and rather highlight existing and emerging socio-economic inequalities in the globally connected post-industrial city in regions of political instability and economic uncertainty and its relationship with crime and crime prevention.

140

INTRODUCTION

Crime is a complex and multi-faceted social and geographic phenomenon. The study of crime was initially dominated by research in the fields of criminology, sociology and law but in the past 70 years, professional geographers have developed spatial-ecological crime perspectives to supplement existing criminological research. The spatial-ecological perspectives of crime are noted by Lowman (1986) who provided a detailed 150-year-old history of these perspectives, highlighting an increased interest in environmental criminology since the 1970s. Spatial-ecological perspectives typically examine the social and economic conditions of neighbourhoods in combination with the spatial location of offences and/or offenders. The interdependent link between generators of criminal behaviour and geography is investigated to provide clearer insight into the development of criminality. The work of social ecologists Shaw and McKay (1942) is regarded as the quintessential piece of 'geographical' research involving crime in the first half of the 20th century. Their social disorganisation theory was developed at the Chicago School of urban sociology and involved the mapping of thousands of incidents of juvenile delinquency and subsequent analysis of the relationships between delinquency and various social conditions (Harries, 1999). Social disorganisation and resulting crime and delinquency rates depended on the environment's socio-economic status, residential mobility and ethnic heterogeneity. Traditionally, the ecological theories of crime looked for explanations of individual actions in general features of the social structure in which an individual is embedded (Anselin *et al*., 2000).

Urban environmental-criminology takes into account both crime areas and the urban origins of offenders. Davies and Herbert (1994) identified three broad domains associated with the environmental variation in crime areas and offender origins: the area content domain, behaviour domain, and cognitive-affective domain. Based on excessive research following the ecological tradition in the context of the modern city, Racine (2002) asked for a shift in focus towards perceptual issues. However, we maintain that a comprehensive theory on environmental-criminology should incorporate both crime areas and offender origins, and cover all three domains of variation. Herbert (2002) acknowledged that environmental-criminology in the past mainly focussed on the places at which crime events occur and largely neglected the areas of residence of offenders. This is also true of research on crime in South Africa. We believe that there are two further motivations for a renewed interest in spatial-ecological research on crime, particularly with a focus on offender areas of origin. First, since the 1990s the availability of large-scale population datasets and the proliferation of open source desktop mapping systems together with Geographical Information Systems (GIS) provided for the first time an unrivalled spatial component in the analysis and visualisation of ecologically based crime components. The flexible spatial aggregation capabilities of GIS (Ainsworth, 2002) and the construction of contiguity matrices for representing neighbour relationships between areal units (Anselin *et al*., 2000) are just two examples of the benefits provided by GIS to improve the original method of spatial factorial ecology. Second, traditional ecological research on crime was set in the context of the modern, industrial city. The post-modern, post-industrial city is a different setting with a different social morphology, structure and economic function, and we argue that the knowledge on the spatial ecology of crime obtained in the modern city may not necessarily be

applicable to the changing city of today. The equation between insider and excluded, rich and poor, foreign and minority populations in relation to scale and location in the post-modern city poses a new socio-spatial dynamic that must also affect crime areas and offenders. Likewise, the South African city is fast losing its original modernist-apartheid features whilst becoming globally and regionally connected and displaying more and more the social diversity reminiscent of the post-modern, post-industrial city albeit in the context of the apartheid legacy and in a region of political and economic uncertainty.

The high and rising crime levels across all crime categories are characteristic of South Africa since the inception of the African National Congress (ANC) government in 1994 (Pelser and de Kock, 2000; du Plessis and Louw, 2005). Marais (2003) compared South African crime trends with those of one hundred and thirteen Interpol member countries and highlights South Africa as being in the first position in terms of murder, rape, robbery and violent theft, and in fourth position in terms of violent assault. According to a recent African Peer Review Mechanism report (ARPM), the distinctive feature of crime in South Africa is not so much its volume, but its violence (*Sunday Times*, 2006). A significant amount of GIS-based criminological research has been undertaken in South Africa to investigate the scourge of crime. Although a relatively new technology in South Africa, GIS has been used to map crime incident data for the town of Paarl in order to illustrate the relationship between the crime patterns and the morphological characteristics of the town (Lochner and Zietsman, 1998); plot incidents of gang and organised crime activity in the Western Cape (Redpath, 2001); map child sexual abuse (CSA) incidents in Cape Town and develop social correlates of abuse (Parker and Dawes, 2003); map crime hot spots and high

priority areas for police intervention throughout South Africa (Weir-Smith, 2004); and illustrate how churches could be used as a strategic intervention tool in the fight against sexual and violent crimes in Cape Town (Erasmus and Mans, 2005). Other contributors include Cooper *et al*. (2001), Schmitz and Stylianides (2002) and Schmitz *et al*. (2002). However, studies such as these involve rudimentary crime pattern analysis and don't investigate the spatial origin of offenders and possible motivations behind their behaviour. In contrast, this article attempts to relate, for the first time in a South African context, spatial patterns of offender residence to socio-economic variables in an attempt to explain first, the spatial pattern of offenders within the City of Tshwane Metropolitan Municipality (CTMM) and second, the reasons that contribute, in part, to why an individual decides to offend. This study focuses on existing incarcerated offenders across all crime types in Tshwane municipality. It is readily acknowledged that different motivators exist for different types of crime and that crimes vary in terms of their seriousness and impact on the surrounding neighbourhood. We however visualise the results as providing a broad spatial perspective of offenders in the municipality together with identifying general socio-demographic crime generators within the community.

No single risk factor accounts for a high number of offenders emanating from a particular area and there are a variety of causal mechanisms that operate upon the individual that may lead him or her to a criminal lifestyle. Notwithstanding human irrationality in a decision-making context, the correlation and modelling of crime and/or offender rates with neighbourhood-level contextual factors can reveal interesting insights into the emerging post-modern, post-industrial city in general, and the post-apartheid South African city in particular. Increasing income inequality

linked to multi-ethnicity is a main characteristic of the emerging cities of the world and in a sense South Africa's cities represents an archetype in this regard. South Africa has had one of the highest rates of racially defined social and economic inequalities in the world (Whiteford and van Seventer, 1999). Since the end of apartheid political violence was replaced by growing levels of economic crime (Shaw, 1995; Dursuweit, 2002). At the same time, the traditional white-black income distribution pattern was altered by the emergence of a large ultra-poor class of immigrants from rural areas as well as neighbouring and other African states, the emergence of post-apartheid black middle- and black elite classes, and increasing poverty among white workers affected by de-industrialisation and affirmative action (Pillay *et al*., 2006; Atkinson and Marais, 2006). Hence, in addition to the spatial-ecological aspect – we are also sensitive to the racial dimension of crime.

MATERIALS AND METHODS

The study was conducted in Tshwane, formerly Pretoria. The Tshwane municipality represents one of the six major metropolitan areas in South Africa, and has a diverse population composition and a heterogeneous social and economic structure. The municipality has a population of roughly 2 million inhabitants and was, until recently, a cross-boundary metropolis with 312 administrative units in Gauteng and 59 in North West provinces. The method and procedures utilised comprised four components: first, a crime offender index (COI) locating the area of residence of offenders was constructed at a suburb level of aggregation for Tshwane; second, 91 socio-economic census variables were correlated with the COI and the results tested for statistical significance; third, the census variables that exhibited a significant positive

145

correlation with the COI were introduced as input into Principal Components Analyses (PCA) in order to identify the main factors within the prediction. Last, the component scores produced from the PCA were inputted into a regression analysis in order to determine the effect of each of the component scores on the COI, which acted as the dependent variable. The discussions that follow refer to the suburb level of aggregation and not to infer to the level of the individual.

Spatial distribution of offenders

The primary data for the construction of the COI was the residential addresses of offenders at all five correctional centres within Tshwane. This data was obtained during March 2006 from the management information systems (MIS) of the Department of Correctional Services (DCS) at Pretoria Central Correctional Centre (consisting of Pretoria Medium and Pretoria Maximum), Pretoria Female Correctional Centre, Odi Correctional Centre and Atteridgeville Correctional Centre. The information systems of these five centres provided address data for 1870 offenders residing within Tshwane. These 1870 records include sentenced offenders and exclude awaiting trial detainees as well as parolees. The number of sentenced offenders must be viewed with caution however as Kriel (2005) notes that approximately 28% of the South African prison population are awaiting trail and 60% of this number are usually acquitted as a result of cases being withdrawn for a variety of reasons. The increase in crime is often blamed for the bungled judiciary system and the declining number of convictions (Gouws, 2004), which, for crimes such as hijackings, is less than 2% (Marais, 1999). Although a worldwide phenomenon, the underreporting of crime can also not be underestimated. Victims' surveys in South Africa consistently uncover between 60% and 70% more crime than reported by

official sources, with upwards of 50% of crime in many serious categories being unreported (McCafferty, 2003). Victims of crime in South Africa are often reluctant to report an incident of crime as a result of a general lack of trust in the criminal justice system as a whole, and in the South African Police Service (SAPS) in particular. According to Altbeker (2005) the problem of underreporting is exacerbated by the phenomenon of underrecording by police officers within the SAPS. While there may be more malevolent reasons for the underrecording of crime the truth is that it's near impossible to report and record all crime over a given period. The offender data obtained may therefore not be representative of the exact number of offenders residing within the municipality nevertheless it is the most reliable and complete dataset available for the researchers to examine.

Of the 1870 offender addresses obtained, 125 address locations could not be validated resulting in an aggregation 'hit-rate' of 93,3% (1745 offender addresses). Initially it was attempted to geocode the addresses to gain a point-based spatial perspective of the offender distribution. However, the problems of geocoding within a South African context are noted by Schwabe (2000) and Schmitz *et al*. (2000) and contributed to a hit-rate far below the 85% minimum reliable geocoding hit-rate for crime analysis specified by Ratcliffe (2004). The COI was subsequently aggregated to a suburb level and validated using street and cadastral datasets. The suburb represents the finest spatial level at which Census2001 information has been provided by Statistics South Africa (SSA, 2001) and consists of between 150 – 300 households. The COI result is mapped in Figure 1 and is expressed in rates per 1000 population at risk (ie. population older than 18). The offender rate is classified in terms of its standard deviation from the mean rate to allow high and low rate areas to be easily identified.
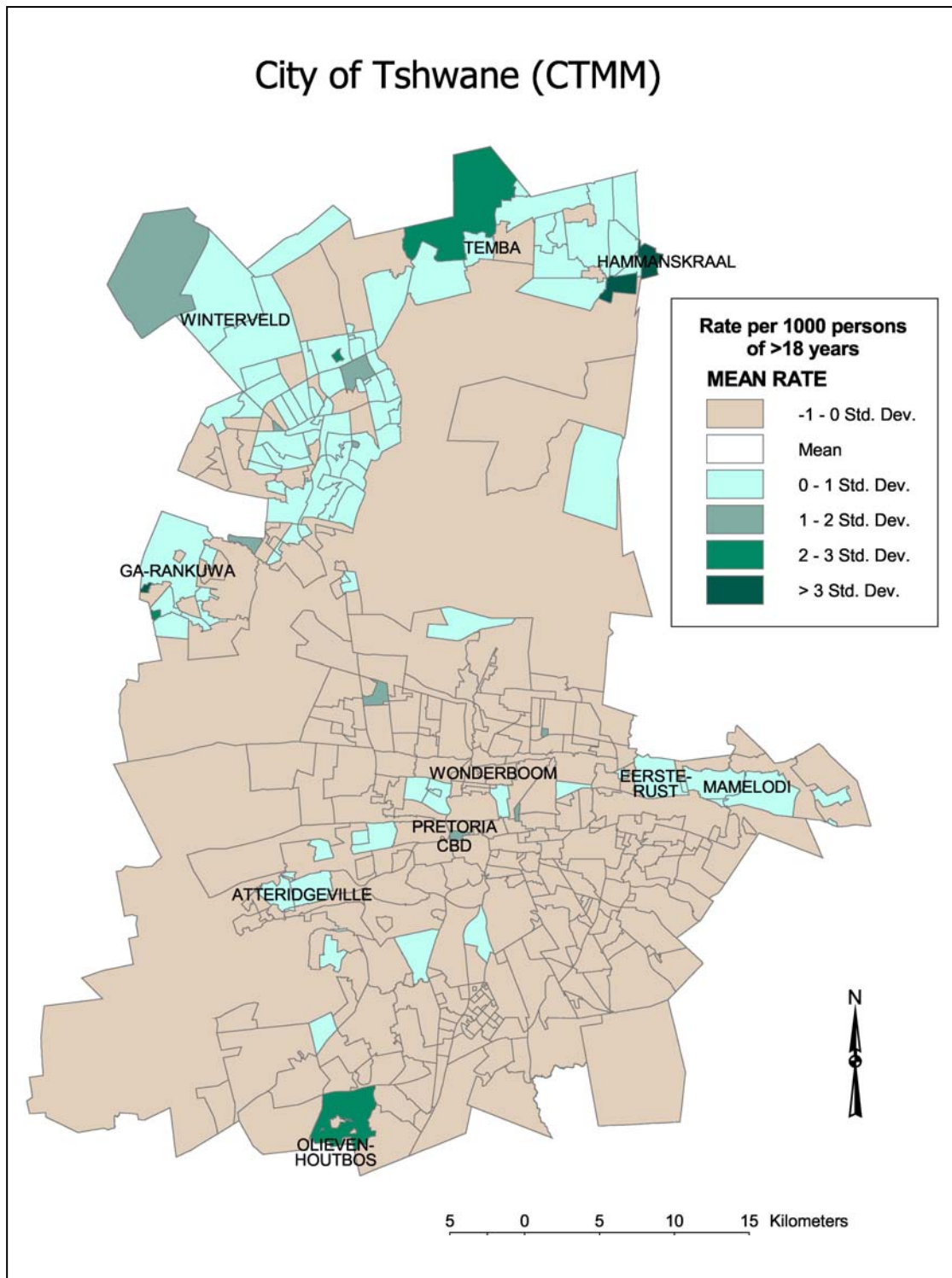
Figure 1:   Mean offender rate per 1000 population older than 18

The prevalence of offenders among the 371 suburbs varied from 0 to 23.53 offenders per 1000 population over 18. Of the 371 suburbs, 70 had a number of offenders more than one-half standard deviation above the mean. These 70 suburbs (18.9% of the suburbs of Tshwane) account for 82.5% of the offenders within Tshwane. Also interesting to note is that 12 suburbs (3% of the suburbs of Tshwane) had an offender rate one and a half standard deviations above the mean. These 12 suburbs account for almost 41% of the number of offenders and are indicative of the highly skewed distribution of the COI within Tshwane. At first glance, the spatial pattern of the COI within Tshwane revealed a high tendency of offenders emanating from impoverished parts of the municipality. Four main offender concentrations can be identified:

(1) A cluster of offenders from particularly the informal sections of the former African homeland border towns of Ga-Rankuwa, Winterveld and Hammanskraal

(2) A concentration of offenders in post-apartheid immigrant settlements on the edge of the city core at, for example Olievenhoutbos and Mandela Village

(3) A concentration of offenders in the former traditional black townships of Atteridgeville, Eersterust and Mamelodi, and

(4) A concentration of offenders in impoverished white areas. The impoverished white areas with high offender rates show two distributive patterns (a) a small-holding cluster at Grootvlei-Onderstepoort in the peri-urban zone between the core city and the homeland border towns, and (b) a concentration at the suburban clusters of Danville-Elandspoort and Booysens-Claremont-Daspoort.

These preliminary findings provided a first empirical clue that crime in Tshwane is a poverty related and multi-racial phenomenon.

Correlational analysis

A correlational analysis was performed to explore the ecological relationships between the COI and 91 census variables. Data on all the variables were taken from South Africa2001 census dataset. The 91 census variables selected were chosen to reflect a range of social and economic circumstances within Tshwane and to help group areas with similar risk profiles. Correlational analysis identified 31 census variables that were positively correlated with the COI at a level of statistical significance. In ecological research, correlation carries no assumption as to causality and a causal relationship cannot therefore be presumed between the COI and 31 census variables because of the influence of confounding variables. A correlation matrix was therefore employed to screen for associations between the dependent variable and the 31 independent variables as well as between the independent variables themselves. The results expectedly revealed a high degree of inter-correlation between the independent variables, a situation that could produce spurious results. Multicollinearity makes determining the importance of any given predictor difficult because the effects of the predictors are confounded due to possible correlations between them (Stevens, 2002). To deal with the problem of multicollinearity the variables were used as input into a principal components analysis (PCA).

Principal Component Analysis (PCA)

Principal axis factor analysis with varimax rotation was employed to derive uncorrelated linear combinations of the 31 selected variables. A set of principal components were computed for the variables in order to empirically determine the number of underlying constructs which account for most of the variance of the COI. The graphical method specified by Cattell (1966) was used to determine the number of components to retain in the analysis. Table 1 indicates the PCA results of the 31 selected census variables and there factor loadings. Only factor loadings greater than .40 or less than -.40 were ascribed practical statistical significance since it was desired that a variable should at least share 15% of its variance with the construct it was going to help label.

Table 1:   Varimax rotated components and loadings for 31 selected variables[a]

	Components				
	1	2	3	4	5
% Households with no electricity for cooking	.898				
% Informal dwellings/shacks	.688				
% Households with no electricity for heating	.899				
% Annual household income: R1-9600	.661				
% Annual household income: R9601-38400			.598		
% Households with no electricity for lighting	.881				
% 1-3 rooms in the household	.620		.400		-.432
% Refuse not removed by authorities	.795				
% 5pers+ living in the household		.694			
% No telephone or cellphone	.764		.411		
% Households with no flush toilets	.791				
% Households with water supply outside their dwelling	.845				
% Aged: 0-14		.790			
% People born in South Africa				.849	
% No schooling	.625				
% Primary school	.705		.517		
% Unemployed	.591	.639			
% Not economically active					.774
% Monthly income: R1-1600	.761		.490		
% Informal area	.767				
% Moved in the area in the last 5 years		.765			
% Never married		.515	.467		
% Living together like married partners	.527				-.605
% Employed persons in construction, plants or elementary occupations	.695		.543		
% People did not live and work in the same place		.705			
% Born outside Gauteng	.516			.403	
% People moved from outside Gauteng into the CTMM				.411	
% People utilise public transport		.809			
% People travel by foot			.812		
% People did not move into CTMM in the past 5 years					
% Paid employee				.832	

[a] All loadings less than .400 have been set as null to aid interpretation

The PCA identified five components explaining 73.4% of the variance. All the factors have loadings which reflect some general degree of impoverishment and paint a portrait of crime generators within suburbs in Tshwane (see Table 2).

Table 2:   Description of factors

Factor Number	Descriptive label	%of variance	Predominant characteristics
1	Social status and income	45.95%	No electricity, little or no education, lack basic services, unemployed, living in informal areas
2	Family characteristics	12.40%	Young children, large household, unmarried, recently moved into the area
3	Unskilled earner	6.70%	Low income earner in basic occupation, small house, lack of telecommunication
4	Residential mobility	4.83%	Born and previously resided inside South Africa but outside Gauteng, paid employee
5	Ageing population	3.52%	High rate of co-inhabitation, small houses, not economically active

Factor 1, which accounted for 45.95% of the variation, was loaded with 18 variables that are commonly regarded as important indicators of socio-economic status. The factor indicates relatively high offender rates in suburbs with low social standing, as it appears as if the percentage of households without electricity for cooking, heating and lighting are driving this interaction. Factor 2, family characteristics, includes the variables percent households with greater than 5 persons, percent never married and percent persons between the ages of 0-14. These variables reflect a young and unstable family structure where single, unemployed individuals are under pressure to provide for a growing number of dependants and/or an extended family. Factor 3, unskilled earner, represents individuals who are manual labourers who earn enough money to survive but with little education and lack of basic amenities. Four variables – born in South Africa, born outside Gauteng, moved into the area from outside Gauteng and paid employee – loaded onto factor 4, residential mobility. Gauteng, the economic hub of South Africa, is a well-established destination for individuals arriving into the country, or from outside the province. The lure of employment and wealth are often unfulfilled and individuals are exposed to criminal behaviour and crime-inducing circumstances. The fifth factor is highly dominated by the 'Not

Economically Active' variable (loading= .774) although the negative loadings for 'percent living together like married partners' and '1-3 rooms in the household' are fairly substantial. The strong negative loadings on these two variables would tend to suggest this factor represents an older segment of the population and explained only 3.5% of the variance in the set of variables. A simple correlation of the variables used to define each factor was undertaken to investigate the communality among them. In all variables used to define each factor, moderate to strong correlations were found. Figure 2 shows the geographic distribution of factor 1 (social status and income), which accounted for almost 50% of the variation in the COI. Similar, to the offender distribution (Figure 1) the highest values on this factor occur on the periphery of the municipality. These predominantly black African areas are generally known to be impoverished and have insufficient social service delivery. A sporadic number of suburbs located close to the city centre also exhibited high values on this factor and are additionally known as impoverished areas consisting of largely white households. The areas to the southeast of the city centre are characterised by low scores and include the more affluent suburbs of Tshwane. Lastly, the strong geographical association between the offender rate distribution and the socio-economic factor scores would tend to reinforce commonly held criminological theory relating social disorganisation to levels of offending within a community.
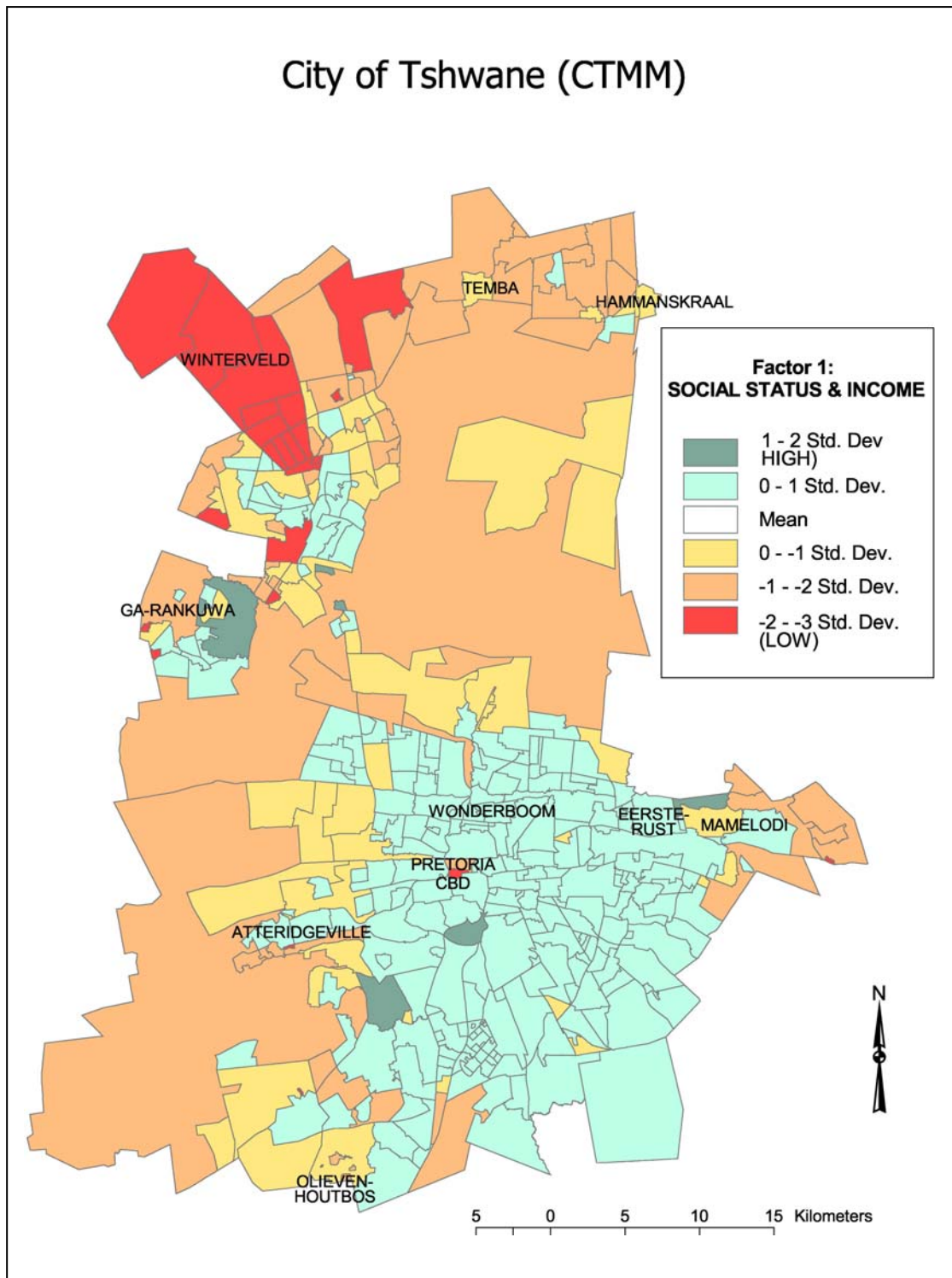
Figure 2:   Factor 1: Social status and income

Regression Analysis

Regression analysis was used to determine which factor scores had the greatest impact or influence on the COI. The factor scores were used as input into an Ordinary Least Squares (OLS) regression model with the log-transformed COI as the dependent variable. Suburbs in Tshwane with no offender index rate were ascribed a null value and were excluded from analysis. The regression model explained 32.2 percent of the variance in the offender rate index (adjusted R^2 = 0.300; F (5,186) = 14.660, $p<0.0001$), therefore producing encouraging results. Table 3 indicates the statistically significant standardised coefficients to the regression model. The social status and income factor had a positive and statistically significant coefficient with the COI and has the strongest explanatory power on the model. This reflects areas with a high level of poverty and lack of basic services and illustrates that social status and income is the best predictor of the COI. Family characteristics, residential mobility and unskilled earner all had positive and statistically significant coefficients. Factor 5, ageing population, was not found to be significant. This implies that the effect of this factor contributes little to the model.

Table 3: Unstandardised and standardised regression coefficients for factors and COI[a]

Variable	b	SE	Beta	p
Constant	-.076	.085		.370
Social status and income (Factor 1)	.341	.055	.395	<.0001
Family characteristics (Factor 2)	.212	.081	.178	<.01
Unskilled earner (Factor 3)	.463	.080	.383	<.0001
Residential mobility (Factor 4)	.604	.197	.221	<.01
Ageing population (Factor 5)	.056	.066	.053	NS

[a] Adjusted R^2 = 0.300; Std. Error of the estimate: 0.860; NS = not significant

RESULTS AND DISCUSSION

The location of offenders within Tshwane appears to be associated with the spatial incidence of four broad factors – low social status and income, a large and young family, unskilled earners and high residential mobility. To refer to these factors as criminogenic risk factors would be presumptuous and it is perhaps wiser to suggest that these factors create a more favourable *environment* for offending, or increase probabilities associated with risk factors (DiCristina, 1995). While this research has indicated that these four factors may account for the high number of offenders emanating from a particular area, it is acknowledged that there are numerous other individual and community-level dynamics that operate upon the individual that may lead him or her into a criminal lifestyle. International and local researchers attribute offending to among others, community disorganisation (Brown, 2001; Maree, 2003), availability of alcohol and drugs (McBride and McCoy, 1993; Rauh, 2002), the type and extent of social networks (Maree, 2003), conditions in schooling (Maree, 2003; Shaw and Tshiwula, 2002), prior victimisation and abuse (Wedge *et al.*, 2000; Peled and Davis, 1995), the availability of police (Schmidt and Witte, 1984; Siegel, 2001) as well as the presence of gangs (Braga, 2003; Maree, 2003). All these motivators while relevant to this study are specialised concepts which are difficult, if not impossible, to represent using the South African census-based variables in an aggregated form across a geographical area. Although this places certain limitations on the study a number of current findings warrant attention.

Offender rate vs social status and income

A low socio-economic status has been noted by a number of South African researchers as a potential cause of the high crime rate in the country (Glanz, 1994; NCPS, 1996; Ehlers and Pimstone, 1998; Schönteich and Louw, 2001). According to Berg and Schärf (2004) these societal problems may be related to apartheid and post-apartheid developments that resulted in a 'culture of violence', unemployment and inequalities. Even after apartheid South Africa has one of the highest levels of inequalities in the world in terms of socio-economic status (McIntyre *et al*., 2000).

The findings of this study indicate a geographic correlation between the incidence of offenders within Tshwane and low socio-economic conditions. The majority of informal settlements within Tshwane are inhabited by black Africans that recently settled in the area and tend to be lacking in basic amenities such as piped water, proper sanitation systems, and in some instances, electricity. Masuku (2002) reports the results of such low social standing and uncertainty can result in ongoing tensions between individuals and families and lead to offending. The Household Infrastructure Index and the Household Circumstances Index, which are both multidimensional poverty indices, developed by SSA rank the high offender index areas identified in Figure 1 as being among the highest ranked areas in terms of poverty in the Gauteng province. The high-risk areas identified in Figure 2 occur within the upper most quintile of deprivation in the General Index of Deprivation of McIntyre *et al*. (2000), and are amongst the lowest ranked in the United Nations Development Programme's Human Development Index (UNDP, 2003). In a number of poverty indices developed by Erasmus (2004) and Cross *et al*. (2005) for Tshwane, the northern areas on the periphery of the municipality associated with high offender rates are identified as the

158

most poverty-stricken and under-serviced areas. Moreover, the study clearly identified a growing tendency of white poverty in various clusters in Tshwane associated with high incidences of offenders.

While socio-economic conditions have been linked to the high and rising crime rate in South Africa (Brown, 2001; Blackmore, 2003), the question remains whether it is these socio-economic conditions that contribute to offending or whether it is the socio-economic inequalities that exist within the municipality? South African society holds a unique position in terms of its social and economic wealth distribution. Whereas in the past prevailing social and economic conditions were predominantly racially defined (Whiteford and van Seventer, 1999), the twelve years of democracy have seen a surge of a black elite class and increasing social and economic inequalities within races as well. These high levels of inequality have also been linked to the high crime rate in the country (Hodgskiss, 2004; Demombynes and Özler, 2005) and fuels further frustration especially in the majority low-income black African population whose socio-economic position has not increased more than a decade after the end of apartheid. The inequalities in the Tshwane municipality that in the past were a result of, and dictated by, apartheid era policies, need to be supplanted by governmental policies aimed at alleviating such socio-economic discrepancies. A low socio-economic status alone is not sufficient to induce criminal behaviour however, and only when their interaction with other interdependent social and cultural variables is considered, can one explain this association.

Offender rate vs family characteristics

Maree (2003) provides a summary of criminogenic risk factors based on South African research findings and lists home factors as the predominant factors followed by those in the community. A study by Mistry and Dhlamini (2001) found that perpetrators of farm attacks in South Africa typically came from an unstable family background while Minnaar (2000) found 'cop-killers' in South Africa are most likely to be unmarried as well as growing up in a dysfunctional household with a shortage of money. According to Barkan (1997) two main familial categories exist in relation to the causation of crime: the role of family structure and family functioning. The former refers to the physical composition of the family and the latter to the inter-actional behavioural patterns and relationships within a family (Schoeman, 2002). In this study, three variables directly associated with these categories were significantly loaded onto the family characteristics factor. The first '% 5pers+ living in the household' may be indicative of a large family or a household with a large number of residents. The second '% Aged 0-14' indicates a young dependent population and the third '% Never married' refers to the marital status of the individuals. It can be inferred from the third variable that there is an absence of a parent in these families. Parental absence and criminality are common bedfellows in international research (see Barkan, 1997; Bartollas, 1997; Siegal and Senna, 2000) while Maree and Prinsloo (2003) highlight family background as a potential criminogenic risk factor within South Africa. Naude (2005) additionally notes that South Africa is experiencing a high level of marital instability, particularly in the reproductive age groups (15-34). Our study confirms that this factor can account for the disruption in family compositions and can act as a crime generator within a community.

Offender rate vs unskilled earner

Brown (2001, p.296) presented a general framework for understanding the possible causes for the high crime rate in South Africa and concluded that "there is no one category of variables (sic) which explains crime in South Africa." Blackmore (2003) reiterated those sentiments but highlighted low income per capita and unemployment as among the most significant explanatory variables. The unskilled earner factor is loaded by low-income variables (ie. monthly and annually) as well as percent employed in unskilled occupations. This factor portrays individuals restricted in job prospects through among others, a lack of education, and earning minimum wage in a menial job. The lack of proper education has resulted in these individuals being unprepared for the competitive labour market in the new South Africa and finding themselves in an unskilled occupation. The low income earned by such individuals can place them under increasing economic strain should the number of independents increase or if there is a death in the family. Such strain could result in these individuals resorting to other means to improve their financial situation, while the additional frustration at the lack of service delivery and the perceived socio-economic inequalities in the municipality may induce other types of crime.

Offender rate vs residential mobility

Residential mobility has shown in this study to have a significant link to criminal behaviour in Tshwane. The rapid growth in the South African economy and concomitant job creation has resulted in international and interregional migration, and in the past 10 years Tshwane has been characterised by a highly mobile population and a great increase in urbanisation. Cross *et al*. (2005) reports Tshwane receives a relatively large proportion of non-Gauteng migrants (27%) compared to its share of

the total provincial population (17%). Migration impedes the development of community ties among residents (Ouimet, 2000) and is believed to negatively affect social integration, which decreases the effectiveness of community informal control mechanisms (Crutchfield *et al*., 1982). Moreover, this migration increases the problem of urban unemployment (Blackmore, 2003) as the promise of jobs is very often unfulfilled and migrants then become squatters in impoverished areas of the city. In a correlation study of poverty and migration in South Africa, Cross *et al*. (2005) found a significant spatial pattern between areas of high migration and areas of high poverty in Tshwane. The areas exhibiting the highest migration rates occurred within the northern suburbs of the municipality, a finding that correlates with the highest offender index values shown in Figure 1. Other characteristics of urbanisation, such as overcrowding, unemployment and increased consumer demands and expectations are themselves often believed to be associated with high crime rates (Schönteich and Louw, 2001). In truth, a reciprocal effect may be experienced between residential mobility and crime, as an increase in crime within an area may lead many residents to leave an area, while many residents who move into an area can lead to competition for limited resources, greater stress and subsequent crime.

Offender rate vs race

According to Schwabe (2000) a subculture of crime has emerged among a black juvenile cohort in South Africa. This cohort perceives itself to be deprived relative to other groups in the country in terms of social and economic wealth. The slow pace of development and the lack of job creation have fuelled feelings of boredom and frustration by this cohort and the direct or indirect result of this is often ostentatiously displayed through crime and violence.

162

Measures of deprivation were investigated in this study and showed that suburbs with the highest levels of social or economic deprivation were also shown to be the suburbs where the majority of offenders emanate. These suburbs typically consist of black Africans but the study also found associations between high offender rates and 'poor white' areas. A racial breakdown of the prison population and the municipality in Tshwane is provided in Table 4 supplemented with the correlation coefficients initially between race and the COI and then between race and the four factors in the OLS model.

Table 4:   Correlation coefficients between race variables and COI and factor scores

Racial variable	Prison pop.	CTMM pop.	COI	Factor 1	Factor 2	Factor 3	Factor 4
% Black African	89.3%	52.9%	.308**	.466**	.587**	.529**	.139**
% White	6.3%	42.7%	-.276**	-.446**	-.503**	-.508**	.135**
% Coloured	3.7%	1.4%	.017	-.123*	.023	.022	.061
% Indian/Asian	0.6%	1.5%	-.024	-.069	-.013	-.100	.016

*$P<0.05$, **$P<0.01$

Table 4 clearly illustrates the overrepresentation of the black African population under correctional control in the Tshwane municipality and the underrepresentation of the white population. The only positive and statistically significant correlation between the COI and any racial group is found between the COI and the percentage of black Africans. A possible explanation for this finding is revealed in the adjacent columns where the black African suburbs consistently exhibit significant positive correlations across all four factors. More importantly however, the table reveals the corresponding vast racial inequalities that exist in Tshwane in terms of all of the factors derived in the PCA and reflected in Table 1. The white population is on average much more affluent than the black African population, however the results of the study has indicated that pockets of low income whites also experience high

offender rates, relating offending to issues other than simply race. A racial stigma is often attached to crime in South Africa (Allen, 2002), but a suburb with a high percentage of people already involved in crime, with poor socio-economic conditions, a disrupted family environment and a high level of mobility will increase the likelihood of an individual resorting to crime regardless of personal characteristics. On this we are clear: crime in South Africa is a problem of deprivation, migration and frustration, not race. The first main policy document to govern policing in South Africa, the National Crime Prevention Strategy (NCPS, 1996, p.18) in 1996 already alluded to the link between deprivation and crime:

> "It is clear that disparities in wealth, development and access to resources, as well as the relative deprivation, which this implies for those on the lower rungs of the economic ladder, do operate as an incentive for criminal activity and contribute as a justification for crime."

While the link between deprivation, migration and crime exists throughout most of the world, the political history of South Africa could partly be used to explain not only the positive relationship identified in this study but also the development of this post-modern, post-industrial city. The establishment of various apartheid laws such as the Group Areas Act of 1950 and the Bantu Education Act of 1953 greatly contributed to the spatial and social segmentation of South African society. In both instances, the majority black population were forcibly removed from existing urban areas to regions or 'homelands' often in rural under-serviced areas or to regions on the periphery of existing white urban centres (Emmett, 2001; Mabin, 2005). This study has shown that not only do these areas currently exhibit high offender rates but they also continue to be under serviced and are among the most socially and economically deprived in the

164

municipality. While small clusters of white suburbs also exhibit high offender rates and exist well within the former white areas, these suburbs were shown to be socially and economically less prosperous than the vast majority of the traditional white areas.

CONCLUSION

Human behaviour is a major guideline in the development of policies and strategies aimed at alleviating pressing societal problems and uplifting quality of life (Schwabe *et al*., 2000). Although at times capricious, this behaviour may be driven by causal mechanisms existing within the individuals' community. This spatial-ecological study has shown that socio-economic factors play an important role in shaping criminal behaviour and identifies for the first time in South Africa a definitive link between the geographical distribution of offenders and social and economic deprivation in an urban context. Suburbs with high levels of social and economic deprivation predictably exhibited high levels of offending whereas the more affluent suburbs in the municipality exhibited low levels of offending. Table 4 provided more evidence of the link between deprivation and levels of offending and inequality whereby the vast inequalities in the municipality (illustrated between races in Table 4) were presented as possible explanations for the vast discrepancies between levels of offending throughout the region.

Knowing what causes crime is not necessarily the same as reducing or addressing the situation (Maree and Prinsloo, 2003). The best approach to reduce crime in South Africa is arguably a holistic approach, with a focus on the many interdependent components that interact to generate criminal behaviour. This study has found strong

correlations not only between low measures of tangible wealth (ie. income) and levels of offending but also between a lack of service provision and the poor supply of basic amenities (ie. electricity) and offending. These findings have important implications for the local practice and policy of the SAPS. In terms of local practice such knowledge should facilitate the initiation of local practice strategies at various levels:

- Operational level: By ranking neighbourhoods into high and low risk, police detectives can initiate proactive micro-level crime-targeting strategies aimed at specific areas in Tshwane

- Middle-management level: Police station commanders can prioritise neighbourhoods and assign officers to high priority areas

- Strategic level: At the strategic level, senior managers or national/provincial commissioners can initiate urban renewal or upgrading policies aimed at addressing the social, economic, or physical 'ills' (eg. lack of resources, lack of basic services) that characterise certain neighbourhoods within Tshwane. This would not only improve the social well being of existing residents but also theoretically result in a reduction of offenders emanating from such areas.

According to Longley (2005) there has been a revival of interest in applications of GIS driven by support by governments for the pursuit of evidence-based policies and a desire to develop a rational basis to set performance targets for public service delivery at the local level. The findings of this study provide tangible evidence from which to guide future policing and crime prevention policies whether it be through the adoption of Crime Prevention through Environmental Design (CPTED) or through other means.

Globalisation and post-modern social fragmentation are changing the appearance of many world cities. New clusters of deprivation often associated with ethnic migration are superimposed over modernist divides between have and have less, and industrial shifts are threatening previously stable populations. These international trends also have an impact on South African society, despite its unique history. Certainly, the geography of crime in this country can no longer be solely explained in terms of the apartheid meta-narrative. An anti-crime strategy in South Africa should take these conditions into account.

ACKNOWLEDGEMENTS

REFERENCES

Ainsworth, P.B. 2002. *Offender Profiling and Crime Analysis*. Willan Publishing: Devon.

Allen, D.B. 2002. Race, crime and social exclusion: a qualitative study of white women's fear of crime in Johannesburg. *Urban Forum*, 13, 53-80.

Altbeker, A. 2005. Positive trends: the 2004/5 crime statistics. *SA Crime Quarterly*, 14, 1-11.

Anselin, L., Cohen, J., Cook, D., Gorr, W. and Tita, G. 2000. Spatial analyses of crime. In Duffee, D. (Ed.), *Criminal Justice 2000: Volume 4. Measurement and Analysis of Crime and Justice*. National Institute of Justice (NIJ): Washington, 213-262.

Atkinson, D. and Marais, L. 2006. Urbanisation and the future urban agenda in South Africa. In Pillay U., Tomlinson R. and Du Toit J. (Eds), *Democracy and Delivery: Urban Policy in South Africa*. HSRC Press: Cape Town, 22-49.

Barkan, S.E. 1997. *Criminology: A Sociological Understanding*. Prentice Hall: New Jersey.

Bartollas, C. 1997. *Juvenile Delinquency, 4th Edition*. Allyn & Bacon: Boston.

Berg, J. and Schärf, W. 2004. Crime statistics in South Africa 1994-2003. *South African Journal of Criminal Justice*, 17, 57-78.

Blackmore, F.L.E. 2003. A panel data analysis of crime in South Africa. *South African Journal of Economic and Management Sciences*, 6, 439-458.

Braga, A.A. 2003. Serious youth gun offenders and the epidemic of youth violence in Boston. *Journal of Quantitative Criminology*, 19, 33-54.

Brown, K.V. 2001. The determinants of crime in South Africa. *The South Africa Journal of Economics*, 69, 269-299.

Cattell, R.B. 1966. The scree test for the number of factors. *Multivariate Behavioural Research*, 1, 245-276.

Cooper, A. K., Byleveld, P. and Schmitz, P.M.U. 2001. Using GIS to reconcile crime scenes. Paper presented at the 5th Annual International Crime Mapping Research Conference, Dallas.

Cross, C., Kok, P., Wentzel, M., Tlabela, K., Weir-Smith, G. and Mafukidze, J. 2005. *Poverty Pockets in Gauteng: How Migration Impacts Poverty*. HSRC Press: Pretoria.

Crutchfield, R.D., Geerken, M.R. and Gove, W.R. 1982. Crime rate and social integration: the impact of metropolitan mobility. *Criminology*, 20, 467-478.

Davies, W.K.D. and Herbert, D.T. 1994. *Communities in Cities: Perspectives in Social Geography*. Bellhaven Press: London.

Demombynes, G. and Özler, B. 2005. Crime and local inequality in South Africa. *Journal of Development Economics*, 76, 265-292.

DiCristina, B. 1995. *Method in Criminology*. Harrow & Heston: New York.

Du Plessis, A. and Louw, A. 2005. The tide is turning: the 2003/4 SAPS crime statistics. *SA Crime Quarterly*, 12, 1-8.

Dursuweit, T. 2002. Johannesburg: fearful city? *Urban Forum*, 13, 3-19

Ehlers, D. and Pimstone, G. 1998. Predicting crime: a statistical glimpse of the future? Institute Security Studies (ISS) Crime Index, No.2, June 1998.

Emmett, T. 2001. Social disorganisation, social capital and violence prevention in South Africa. Paper presented at the 2nd Regional African Safe Communities Conference, Midrand, South Africa.

Erasmus, J.C. 2004. *A Development Index for the City of Tshwane*. HSRC Press: Pretoria.

Erasmus, J.C. and Mans, G.G. 2005. Churches as service providers for victims of sexual and/or violent crimes: a case study from the Paarl community. *Acta Criminologica*, 18, 140-163.

Glanz, L. 1994. *Crime in South Africa: Perceptions, Fear and Victimisation*. HSRC Press: Pretoria.

Gouws, A. 2004. The impact of crime on the legitimacy of the South African political system. *Acta Criminologica*, 17, 78-89.

Harries, K. 1999. *Mapping Crime: Principle and Practice*. National Institute of Justice (NIJ): Washington.

Herbert, D. 2002. Crime and its control in urban environments. In Davis, W.K.D. and Townshend, I. (Eds), *Monitoring Cities: International Perspectives*. IGU Urban Commission: Berlin and Calgary, 541-556.

Hodgskiss, B. 2004. Lessons from serial murder in South Africa. *Journal of Investigative Psychology and Offender Profiling*, 1, 67-94.

Kriel, J. 2005. Emerging trends among the South African inmate population and persons subject to community corrections. *Acta Criminologica*, 18, 100-115.

Lochner, F.C. and Zietsman, H.L. 1998. Using geographical information systems (GIS) for policing in South Africa: a case study in Paarl. *South African Geographical Journal*, 80, 60-72.

Longley, P. 2005. Geographical Information Systems: a renaissance of geodemographics for public service delivery. *Progress in Human Geography*, 29, 57-63.

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.

Mabin, A. 2005. Suburbanisation, segregation and government of territorial transformations. *Transformation*, 56, 41-64.

Marais, H. 1999. Hijacking – road to a fast buck. *Siyaya*, 5, 26-33.

Marais, C.W. 2003. Metro policing: too high a price? *Acta Criminologica*, 16, 138-150.

Maree, A. 2003. Criminogenic risk factors for youth offending. In Bezuidenhout, C. and Joubert, S. (Eds), *Child and Youth Misbehaviour in South Africa: A Holistic View*. Van Schaiks: Pretoria, 51-79.

Maree, A. and Prinsloo, J. 2003. An exploration of crime and crime risks with specific reference to South Africa. In Hough, M. and du Plessis, A. (Eds.), *Combating Crime in South Africa: Contemporary Perspectives*. Institute for Security Studies (ISS): Pretoria, 171-187.

Masuku, S. 2002. Prevention is better than cure: addressing violent crime in South Africa. *SA Crime Quarterly*, 2, 5-12.

McBride, D.C. and McCoy, C.B. 1993. The drugs-crime relationship: an analytical framework. *The Prison Journal*, 43, 257-278.

McCafferty, R. 2003. Murder in South Africa: A comparison of past and present. Unpublished report. Available at: http://www.frontline.org.za/articles/murder_southafrica.doc, last accessed on 28 November 2006.

McIntyre, D., Muirhead, D., Gilson, L., Govender, V., Mbatsha, S., Goudge, J., Wadee, H. and Ntutela, P. 2000. Geographic patterns of deprivation and health inequities in South Africa: informing public resource allocation strategies. Health Economics Unit and Centre for Health Policy, Cape Town.

Minnaar, A. 2000. Profiling 'cop killers' in South Africa. *Crime research in South Africa*, 1,1.

Mistry, D. and Dhlamini, J. 2001. Perpetrators of farm attacks: an offender profile. Unpublished report for the Institute for Human Rights and Criminal Justice Studies, South Africa.

Naudé, W. 2005. Poor, young and unmarried: men and crime in South Africa. *Acta Criminologica*, 18, 126-139.

NCPS (National Crime Prevention Strategy). 1996. Pretoria, South African Department of Safety and Security.

Ouimet, M. 2000. Aggregation bias in ecological research: how social disorganization and criminal opportunities shape the spatial distribution of juvenile delinquency in Montreal. *Canadian Journal of Criminology*, 42, 135-156.

Parker, Z. and Dawes, A. 2003. Child sexual abuse in Atlantis. Research report, Children's Institute, University of Cape Town, South Africa.

Peled, E. and Davis, D. 1995. *Group Work with Children of Battered Women: A Practitioner's Guide*. Sage: London.

Pelser, A. and de Kock, C. 2000. Violence in South Africa: a note on some trends in the 1990s. *Acta Criminologica*, 13, 80-94.

Pillay, U., Tomlinson, R. and Du Toit, J. 2006. Introduction. In Pillay, U., Tomlinson, R. and Du Toit, J. (Eds), *Democracy and Delivery: Urban Policy in South Africa*. HSRC Press: Cape Town, 1-19.

Racine, J.B. 2002. Explaining, regulating or monitoring violence in the cities of tomorrow. In Davis W.K.D. and Townshend I. (Eds), *Monitoring Cities: International Perspectives*. IGU Urban Commission: Berlin and Calgary, 557-598.

Ratcliffe, J.H. 2004. Geocoding crime and a first estimate of a minimum acceptable hit rate. *International Journal of Geographical Information Science*, 18, 61-72.

Rauh, J. 2002. Crime and crime prevention: the views of police station commissioners. Available at: http://www.wits.ac.za/csvr/papers/papcrjrl.htm, last accessed on 25 May 2006.

Redpath, J. 2001. The bigger picture: the gang landscape in the Western Cape. *Indicator South Africa*, 18, 34-40.

Schmidt, P. and Witte, A.D. 1984. *An Economic Analysis of Crime and Justice: Theory, Methods, and Applications*. Academic Press, Inc.: Toronto.

Schmitz, P.M.U., Potgieter, M., Du Plessis, P., Cooper, A.K. and Schwabe, C.A. 2000. Activity A7: Packaging and rollout, Part 1: Theoretical aspects of GIS and geocoding. Research report, DACST Innovation Fund Project Number: 13102.

Schmitz, P.M.U. and Stylianides, T. 2002. Mapping crime levels and court efficiency per magisterial district in South Africa. Paper presented at the 6th Annual International Crime Mapping Research Conference, Denver.

Schmitz, P.M.U., Cooper, A.K. and Quick, G. 2002. Using satellite imagery for crime mapping in South Africa. Paper presented at the 6th Annual Crime Mapping Research Conference, Denver.

Schoeman, M. 2002. A classification system and an inter-disciplinary action plan for the prevention and management of recidivism. Unpublished PhD Thesis, University of Pretoria, South Africa.

Schönteich, M. and Louw, A. 2001. *Crime in South Africa: A Country and Cities Profile*. Institute for Security Studies (ISS): Pretoria.

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

Schwabe, C.A., Schurink, W.J. and Makakase, M. 2000. Activity A2: Investigation into the most useful crime forecasting methodologies, Part 3: information required for strategic and operational crime forecasting. Research report, DACST Innovation Fund Project Number: 13102.

Shaw, M. 1995. Towards safer cities? Crime, political transition and changing forms of policing control in South Africa. *African Security Review*, 4, 4-11.

Shaw, C.R. and McKay, H.D. 1942. *Juvenile Delinquency and Urban Areas*. University of Chicago Press: Chicago.

Shaw, M. and Tshiwula, L. 2002. Developing citizenship amongst urban youth in conflict with the law in Africa. Paper presented at the International Conference on Youth in Conflict with the Law, Port Elizabeth, South Africa.

175

Siegel, L.J. 2001. *Criminology: Theories, Patterns and Typologies, 7th Edition*. Wadsworth: USA.

Siegel, L.J. and Senna, J.J. 2000. *Juvenile Delinquency: Theory, Practice and Law, 7th Edition*. Wadsworth: USA.

SSA (Statistics South Africa). 2001. *Census2001*. Pretoria, Statistics South Africa.

Stevens, J. 2002. *Applied Multivariate Statistics for the Social Sciences*. Lawrence Erlbaum Associates: New Jersey.

Sunday Times. 2006. 'Fight crime, Africa tells SA. Peer review panel lists threats to stable democracy – and lawlessness is No 1', 3 December, p.1.

UNDP (United Nations Development Programme). 2003. South Africa Human Development Report, Oxford University Press: Cape Town.

Wedge, P., Boswell, G. and Dissel, A. 2000. Violence in South Africa: key factors in the background of young serious offenders. *Acta Criminologica*, 13, 31-38.

Weir-Smith, G. 2004. Crime mobility: spatial modelling of routine activities of arrestees and substance abusers in South Africa. *GeoJournal*, 59, 209-215.

Whiteford, A. and Van Seventer, D.E. 1999. *Winners and Losers: South Africa's Changing Income Distribution in the 1990s*. WEFA: Pretoria

CHAPTER 6

A GEODEMOGRAPHIC PROFILER FOR HIGH OFFENDER PROPENSITY AREAS IN THE CITY OF TSHWANE, SOUTH AFRICA

Gregory Dennis Breetzke and Andre Carl Horn

ABSTRACT

Post-apartheid South Africa has been plagued by an increase in crime across all categories. While a significant amount of criminological research has been undertaken in the country, the spatial analysis of crime and offenders, a basic prerequisite for a functional crime management strategy, has not been adequately addressed at a sufficiently fine scale of aggregation. This paper reports on the geodemographic development of offender risk profiles for neighbourhoods in the City of Tshwane Metropolitan Municipality (CTMM) in South Africa. Geodemographics is a relatively new geo-analytical technique that is being increasingly used in policing applications to complement law enforcement techniques and provide further insight into offenders and their offences. Findings of the study indicate that neighbourhoods at a high risk for offender development are amongst the most socially and economically deprived in the municipality and are disproportionately occupied by black Africans. The results highlight a need to re-assess the current law enforcement approach to crime reduction in the country and return to the crime prevention initiatives that were part of the National Crime Prevention Strategy (NCPS) of the 1990s.

178

INTRODUCTION

Crime is a complex and multi-faceted spatial phenomenon. Two major theories suggest the importance of space for understanding crime: the social disorganisation theory (Shaw and McKay, 1942) and the routine activities theory (Cohen and Felson, 1979). According to the social disorganisation theory, crime and delinquency depend on a neighbourhood's level of social and economic deprivation, residential mobility and ethnic heterogeneity (Cahill and Mulligan, 2003), while the routine activities theory proposes that crime will take place within a criminal's area of social interaction (Weir-Smith, 2004). Other theories attribute the spatial patterning of crime to social disadvantage (Simcha-Fagan and Schwartz, 1986; Smith and Jarjoura, 1988), segregation effects (Logan and Messner, 1987; Shihadeh and Flynn, 1996; Krivo *et al*., 2006), levels of economic and social deprivation (Kawachi *et al*., 1999; Peterson *et al*., 2000), and to the intersection of criminal opportunities with offenders' motivation, mobility and perceptions of target areas (Brantingham and Brantingham, 1991).

The latter researchers are synonymous with the concept of 'environmental criminology' wherein great emphasis is placed on the spatial dimension of criminal behaviour. Traditionally, the two central concerns of environmental criminology have been explaining the spatial distribution of offences and explaining the spatial distribution of offenders (Bottoms and Wiles, 2002). In recent times investigations into the geographic distribution of offences has dominated environmental criminological research (Herbert, 2002) not least because of the pursuit of situational crime prevention strategies which have had a good record in the short-term reduction

of crime (Clarke, 1995). Investigations into the residential origins of offenders on the other hand involve an examination into the root causes of crime resulting from, and associated with, the residential environment of offenders and are seen as a more long-term solution to crime reduction and therefore currently receives less attention, especially in South Africa (Leggett, 2004a). The residential environment of the offender remains however a vital part of the crime equation, relating both to measurable qualities, such as the distance to crime, and to wider issues of the social and economic conditions that produce criminality. Any crime reduction strategy needs to take both into account and in the context of the fast-changing post-modern, post-industrial city the time may be appropriate to redress this imbalance.

While a substantial amount of criminological research has been undertaken in South Africa, a number of researchers note an absence of aggregate level empirical research focussing on crime causation and appropriate crime reduction strategy (see Glanz, 1996; Brown, 2001). With the recent exception of Breetzke and Horn (2006), data of offenders has rarely been analysed at any spatial scale in South Africa, while the demographic risk factors of persons engaging in crime in the country are largely unknown (Schönteich, 2005). In a country whose population is highly racially stratified and where crime levels are also among the highest in the world (Gouws, 2004; Marais, 2003; Pelser and de Kock, 2000; du Plessis and Louw, 2005), the need to identify ecological determinants of crime and profile at-risk neighbourhoods is vital not least because of the implication for future policing and public policy formation.

This study aims to build offender risk profiles for neighbourhoods in the City of Tshwane Metropolitan Municipality (CTMM) in South Africa using geodemographic techniques. The Tshwane municipality is located in the Gauteng province of South Africa and is one of six major metropolitan areas in the country. The municipality, established in 2000, consists of formerly white neighbourhoods around a central business district (CBD); the former apartheid townships of Atteridgeville (black African) and Laudium (Indian) on the western edge; the townships of Eersterus (Coloured) and Mamelodi (black African) on the eastern edge; and an arc of late-apartheid black African townships on the border of the former Tswana homeland in the northern periphery of the municipality. These outlying townships include Ga-Rankuwa, Mabopane, Soshanguve, Winterveld and Temba. The pre-1994 urban structure has been largely retained except for the almost complete replacement of whites by black Africans in large parts of the inner city; the expansion of black African townships with informal housing; and the establishment of a few informal settlements such as Olievenhoutbos amidst previously white suburbs. The municipality has a population of roughly 2 million inhabitants and has a diverse population composition and a heterogeneous social and economic structure.

The proposed geodemographic classification system is based on the inductive assumption that current offenders are similar to 'potential' offenders or are at least influenced by similar neighbourhood-level factors and have the same general motivations. Variables selected for the creation of the geodemographic system are shown to correlate geographically with the number of offenders within a neighbourhood. The benefit of such a system lies not only in its ability to profile potential criminals and improve crime detection rates but more importantly to provide

a spatial dimension within which to assess current crime reduction policy initiatives in the country. Different social structural conditions of at-risk neighborhoods across racial and ethnic divides can additionally be investigated. A brief history of the two overarching policy documents that have governed policing in South Africa since the inception of the African National Congress (ANC) government in 1994 is outlined below.

A BRIEF HISTORY OF CRIME PREVENTION INITIATIVES IN SOUTH AFRICA: POST-1994

The National Crime Prevention Strategy (NCPS) (1996-1999) was the first official policy document on crime management of the new democracy. It advocated a macro-strategy towards crime and aimed at shifting the emphasis from reactive 'crime control' towards proactive 'crime prevention' (South Africa, 1996). The NCPS was rooted in the Reconstruction and Development Plan (RDP), an integrated, interdepartmental and holistic approach towards post-apartheid change and development that guided the entire Nelson Mandela administration. The NCPS was based on a four pillar approach to crime prevention that included the reforming of the criminal justice system; changing the public's values and attitudes to crime; reducing crime through environmental design and development; and combating transnational crime. Sweeping as the strategic framework of the NCPS may have been, researchers (see Simpson and Rauch, 1999; Naudé, 2000) were soon critical of the lack of infrastructure and information sources with regard to the implementation of the strategy's crime prevention programmes and who should ultimately take responsibility for them.

182

The succession of Nelson Mandela by Thabo Mbeki in 1999 and the replacement of the RDP by a Growth, Employment and Reconstruction (GEAR) strategy effectively meant a change from idealism to pragmatism. A major consequence was the almost immediate administrative fragmentation of the state. In response to mounting pressure over increasing crime levels, a new approach to crime reduction was quickly ushered in (du Plessis and Louw, 2005). In contrast to the NCPS's crime prevention approach, the National Crime Combating Strategy (NCCS) (2000-present) is effectively a law enforcement approach in which areas affected by high crime rates, particularly violent crime, are clustered into crime-combating zones, which are then targeted for aggressive high density street level policing (Mokonyane, 2000). Moreover, while the NCPS was theoretically an interdepartmental policy aimed at impacting on the supposed causes of crime (Pelser and Louw, 2002), the NCCS is explicitly a security cluster matter that was created without consultation from other government departments such as health, education and social development in particular (du Plessis and Louw, 2005) and has been likened to the authoritarian police practices of the apartheid era (Leggett, 2004a). It is difficult to evaluate the mandate of the NCCS to stabilise crime in high priority areas, and hence compare the trade-off in crime reduction policy approaches, given the fact that police station-level crime statistics are denied to the public (Leggett, 2004a). The increase in crime levels pre- and post-1999 (Marais, 2003; Berg and Schärf, 2004; Altbeker, 2005) and the heightened fear of crime among residents of the country (Mistry, 2004) suggest that the NCCS has not fared particularly well. It is anticipated that the creation of geodemographic offender risk profiles for the Tshwane municipality will not only be the first attempt to provide insight into the offender ecology of the post-apartheid South African city but will also enable policy makers to assess both past (NCPS) and present (NCCS) crime reduction

183

policy initiatives and in doing so assist in the development of effective strategic systems to guide future interventions.

GEODEMOGRAPHICS AND CRIME

Geodemographics is the "analysis of people by where they live" (Sleight, 1997, p.16) and is posited on the complementary assumptions that the areal unit of measurement such as a census area, encloses a broadly homogenous social and economic environment and that individuals in the same neighbourhood share habits, preferences and to some extent behaviour (Curry, 1993; Harris *et al*., 2005). Neighbourhoods are clustered into groups based on similarities in terms of various demographic and social variables, with the classification being both mutually exclusive and collectively exhaustive (Harris *et al*., 2005; Schwabe, 2000). In terms of their criminological applications, geodemographic systems have been used to better deploy police resources at a variety of spatial scales throughout England and Wales (Ashby and Longley, 2005); analyse the geographic variations in crime and policing performance (Ashby, 2004); identify high crime risk neighbourhoods in Britain (Mayhew *et al*., 1993); predict levels of social disorganisation, social capital and collective efficacy (Williamson *et al*., 2006) and lastly, to indicate how levels and patterns of youth offending vary between neighbourhood types (Williamson *et al*., 2005). In the majority of these instances geodemographic solutions are used to complement existing policing techniques, provide support for planning by policing authorities, or to provide further insight into offenders or criminal offences. In the United Kingdom (UK), commercial neighbourhood typologies such as MOSAIC[TM] and ACORN[TM] have been recently supplemented by the development of an academically scrutinised

National Area Classification of 2001 Census Output Areas (OAs) developed by Vickers (2006). The system is one of the first social classifications covering the entire UK to be freely available and fully documented. Geodemographic systems such as that of Vickers (2006) as well as the many commercial classification systems are valuable research tools that can be utilised to gain a better socio-geographic understanding of the make-up of society. Sadly, the growth of such systems in South Africa has yet to reach these levels but some applications of the technology have been forthcoming particularly in the private sector.

CLASSIFICATION METHODOLOGY

The first major decision in the construction of a geodemographic classification system is to determine which variables to select as input into the clustering algorithm. In the creation of previous crime-related classifications Harper *et al*. (2002) and Sheldon *et al*. (2002) selected eighteen variables to reflect differing policing problems based on the Police Funding Formula in the UK as well as variables suggested in literature as having "an association with crime and disorder, or were important characteristics in distinguishing different types of policing problems" (Harper *et al*., 2002, p.8). In this study however a data driven methodology is adopted governed predominantly by the lack of aggregate level research available in the country by which to inform variable selection as well as the uncertainty regarding the applicability of international criminological theories which has been noted by local researchers to be limited when applied in a South African context (see Labuschagne, 2003; Ovens, 2003). As a result of these considerations a number of variables were therefore selected that are shown to correlate geographically with the number of offenders within a neighbourhood. In a

similar study Leigh *et al*. (2000) used statistical correlations with crime rates to assist in the identification of variables to use when grouping similar policing and crime reduction areas in the UK. In order to determine which socio-economic and demographic variables positively correlate with the number of offenders within a neighbourhood an offender index was compiled for the Tshwane municipality.

Index of offenders

An offender index was created using residential address data obtained during March 2006 from the Management Information Systems (MIS) at all five correctional centres located within the Tshwane municipality. These correctional centres include Pretoria Central (consisting of Pretoria Medium and Pretoria Maximum), Pretoria Female, Odi and Atteridgeville. A total of 1745 verifiable offender addresses were obtained. These 1745 records include sentenced offenders and exclude awaiting trial detainees as well as parolees. The offender addresses were aggregated to a suburb level and are shown in Figure 1. The suburb represents the finest spatial level of aggregation at which Census2001 data has been provided by Statistics South Africa (SSA) and consists of between 150 – 300 households. While it is readily acknowledged that census areas do not correspond to socially defined neighbourhoods, Sampson (1992) notes that they do possess 'ecological integrity' and have also been successfully used in various social ecological approaches to the study of crime (ie. Coulton *et al*., 1995; Lockwood, 2004; Ernst, 2001). The index is expressed as a rate per 1000 population above the age of 18 with the offender rate being classified in terms of its standard deviation from the mean rate.
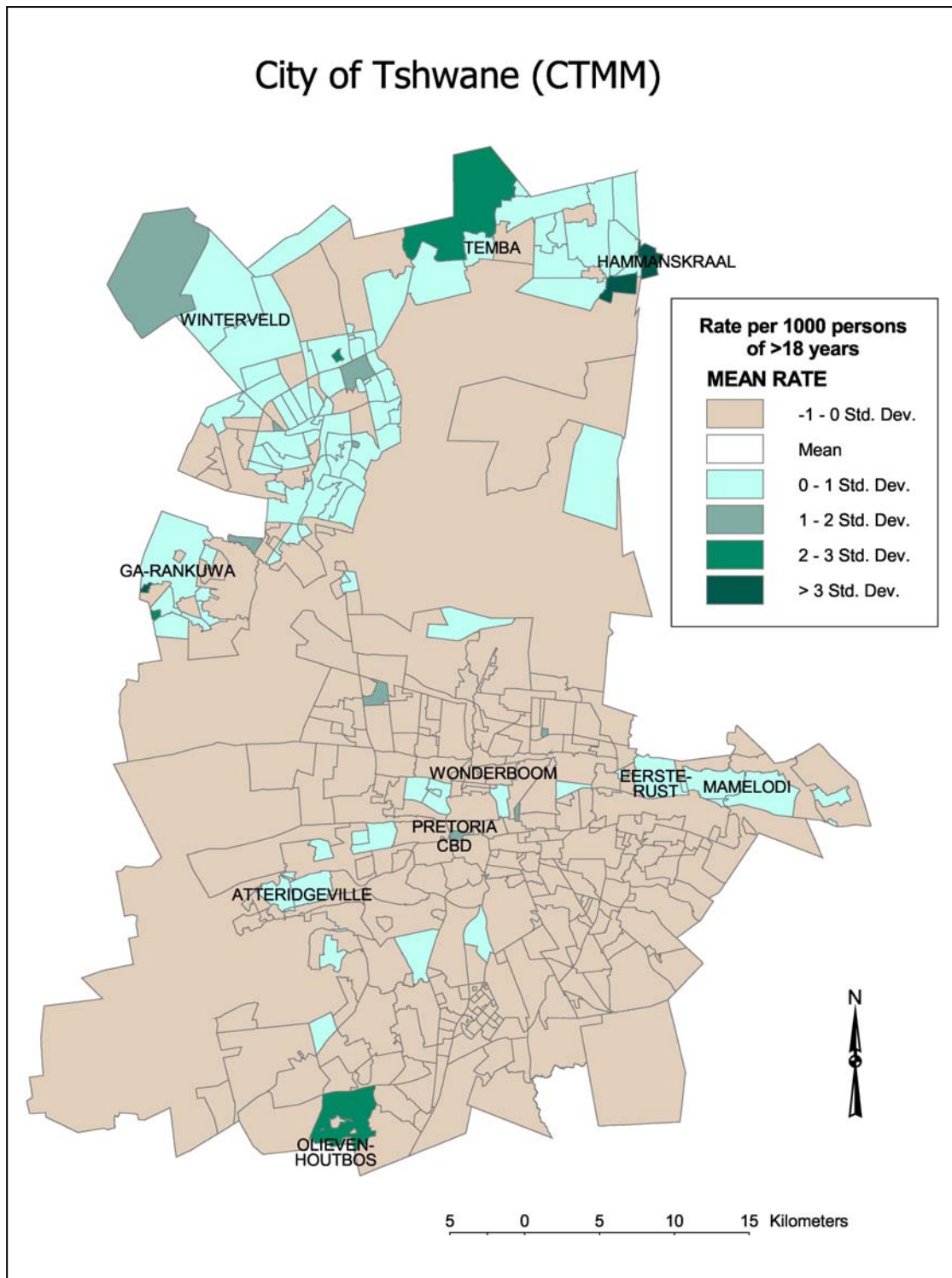
Figure 1:   Mean offender rate per 1000 population older than 18

The small population counts in some suburbs within the municipality made the offender index vulnerable to outliers. In an adjustment similar to Bukenya (2005), all observations which deviated by more than five standard deviations from the mean were replace with the mean values calculated over only the positive observations. The frequency of offenders ranged from 0 to 23.53 offenders per 1000 population over 18 years of age. Most high offender values are concentrated in the northern and eastern regions of the municipality. These areas are typical of the impoverished former black African homeland border townships occurring on the periphery of the municipality. In order to identify the variables that have an association with the levels of offending in a suburb, a correlation analysis was performed between the offender index and a range of socio-economic and demographic census variables.

Correlation analysis

An initial set of 250 census variables were identified to correlate with the offender index. The variables are taken from the Census2001 dataset and were grouped together according to their socio-economic and demographic similarities to form 91 composite variables. A correlation analysis using Spearman's non-parametric measure was run between these 91 variables and the offender index and highlighted 31 variables that were positively correlated at a level of statistical significance ($p < 0.01$). The rank-ordered 31 significant variables are displayed in Table 1.

The strength of the 31 correlations ranged from 0.615 for the percentage of households with more than 5 residents to 0.173 for the percentage of residents born outside the Gauteng province of South Africa. All of the variables reflect some generalised degree of impoverishment and deprivation within the municipality with a

number of variables such as employment status, education, income levels and mobility being common ecological determinants of criminality in international studies (Crutchfield *et al*., 1982; Grant and Martinez, 1997; Carmichael and Ward, 2000; Fajnzylber *et al*., 2002; Cahill and Mulligan, 2003; Andresen, 2006; Evans, 1980; Oh, 2005). As a caveat to this analysis, it should be noted that these variables are often proxies for multifaceted processes that are the key to understanding offender propensity. Residing in a house with more than five residents does not make you a criminal *per se*, rather it is the overriding social and economic conditions that create a more favourable environment for offending or increase probabilities associated with risk factors.

Table 1: Ranked positive correlations between offender index and 91census variables

Variable	Variable description[a]	Spearman's ρ
1	Households with more than 5 residents	.615**
2	Unemployed	.581**
3	Residents utilise public transport	.545**
4	Aged: 0-14	.530**
5	Residents did not move into the CTMM[b] in the past 5 years	.514**
6	Never married	.508**
7	Residents with no telephone or cellphone	.485**
8	Residents born in South Africa	.477**
9	Annual household income: R9601-38400	.473**
10	Residents who moved in the area in the last 5 years	.448**
11	Residents who do not live and work in the same place	.434**
12	Annual household income: R1-9600	.413**
13	Residents moved from outside Gauteng province into the CTMM	.405**
14	Households with no electricity for cooking	.396**
15	Monthly income: R1-1600	.394**
16	Unskilled occupations	.390**
17	Residents with no schooling	.377**
18	Residents with a primary school education	.376**
19	Households with no electricity for lighting	.361**
20	Living in an informal area	.350**
21	Not economically active	.347**
22	Households with no flush toilets	.331**
23	Households with no electricity for heating	.313**
24	Residents travel by foot	.313**
25	Living together like married partners	.312**
26	Informal dwellings/shacks	.304**
27	Refuse not removed by authorities	.289**
28	1-3 rooms in the household	.271**
29	Households with water supply outside their dwelling	.239**
30	Paid employee	.238**
31	Born outside the Gauteng province	.173**

**$p<0.01$
[a] All are percentages
[b] CTMM – City of Tshwane Metropolitan Municipality

Reducing the number of variables

A correlation matrix was calculated for the 31 cluster formative variables across the 371 suburbs within the municipality. The correlation matrix expectedly revealed a high degree of intercorrelation between the selected variables introducing the threat of data redundancy. In conventional classification methodology a number of methods exist to reduce the number of highly correlated input variables. These include creating further composite variables, applying factor analysis or simply excluding a correlated

variable to ensure that no dimension or category is over-represented. In the latter, the decision of which variable to exclude is usually made in consultation with classification experts or after other ancillary evidence has been considered such as a variable's distribution or geographic consistency (see Harper *et al*., 2002; Vickers *et al*., 2005). In this study, however, in order to compartmentalise the offender concept and simultaneously deal with the problem of multicollinearity a number of factors were constructed using Principal Components Analysis (PCA). A varimax-rotated analysis yielded five factors explaining just under 75% of the variation in the dataset. Table 2 provides a description of each factor together with the amount of variance that each explains.

Table 2:   Description of PCA factors

Factor Number	Descriptive label	% of variance	Predominant characteristics
1	Social-economic status	45.95%	No electricity, little or no education, lack basic services, unemployed, living in informal areas
2	Family characteristics	12.40%	Young children, large household, unmarried, recently moved into the area
3	Unskilled earner	6.70%	Low income earner in unskilled occupation, small house, lack of telecommunication
4	Residential mobility	4.83%	Born and previously resided inside South Africa but outside Gauteng, paid employee
5	Ageing population	3.52%	High rate of co-inhabitation, small houses, not economically active

While factor analysis techniques in geodemographics have been criticised by researchers for among others, blurring distinctions between cluster types (Harris *et al*., 2005) and causing harm to data (Openshaw, 1995), the technique has been successfully used to build the PiN and SuperProfiles geodemographic classifications in the UK (Brown and Batey, 1994; Sleight, 2004) as well as to build rural typologies in Europe (Copus, 1996; Ballas *et al*., 2003). Another option that was considered in

the classification methodology was the use of weights for individual variables. While a number of weighting algorithms and strategies undoubtedly exist in geodemographics it was ultimately decided to apply equal weightings to all variables (they were all set to 1). Equal weights were applied in the study for a number of reasons. First, variables were selected for the classification system that were positively correlated with the offender index (ie. number of offenders within a suburb) therefore these variables are similar in terms of their relationship to offender rates. By weighting a variable higher than another, this could make the classification more suitable for one interpretation of offending than for another. Second, there is already high cocorrelation between the 31 variables that was difficult to quantify. The addition of weights to all or some variables would make it difficult to predict what the effect may be. Consistent with the data-driven methodology of the study all available census variables were therefore included and a filtering process *viz a viz* correlation analysis employed as a means of highlighting those variables that appear to be related to levels of offenders within a suburb.

K-mean cluster analysis

An iterative relocation-clustering algorithm known as *k*-means was used to cluster the 371 suburbs of the city of Tshwane into similar profiles based on the five factors outlined above. The *k*-means clustering proposed in Fisher (1958) is an algorithm that classifies objects based on variables into *k* number of groups, where *k* is a positive integer. This grouping is done by minimising the sum of squares of distances between the data and the corresponding cluster centroids. Although the algorithm has shown to be sensitive to the choice of initial seed sites (Harris *et al*., 2005), it is computationally fast, sensitive to outliers and has been used by a number of

researchers within a variety of classifications (see Debenham *et al*., 2003; Harper *et al*., 2002; Ballas *et al*., 2003; Vickers *et al*., 2005). Two important issues need to be addressed in *k*-means clustering: the first is the number of clusters to produce and second, the number of cases within each cluster. The number of clusters to produce through *k*-means is determined *a priori* and is driven more along usefulness and local knowledge than on scientific theory (Vickers, 2006). A number of seed sites were tried as well as a number of cluster solutions (four to ten) run on the data to determine the optimum solution. All initial cluster solutions contained clusters with very small membership values. After an examination of these preliminary results and according to a solution proposed by Debenham *et al*. (2001), all suburbs with a low population total, in this instance less than 50 residents, were removed and the remaining suburbs reclassified. A total of 17 suburbs were excluded from further classification with a combined population loss of 251 (ie. an average of 14.67 people per suburb). Although compromising the collectively exhaustive ideals of geodemographics the reality is that such low population suburbs are susceptible to extreme values that can warp the clustering solution. This left a total of 354 suburbs to be clustered. Ultimately, the seven-cluster solution produced the clearest distinguishable clusters, with no evidence of extreme outliers to distort the findings. An examination of the clusters indicated optimal homogeneity among suburbs within each cluster. Figure 2 shows the spatial pattern for the cluster solution while Table 3 indicates the cluster means for each respective factor, ranked in discriminative power according to ANOVA F-values.

ANOVAS for all factors showed high statistical significance ($p < 0.001$, $F > 3.843$) indicating that the clusters differed notably from one another on the basis of the five factors. The best discriminator based on ranked ANOVA F-values, was socio-economic status ($F = 178$), which was closely followed by family characteristics ($F = 176$) and then unskilled earner ($F = 116$). The mean offender rate across the municipality was 1.24 offenders per 1000 population over 18 years of age. In order to generate a risk profile for the municipality, all geodemographic groups that exhibited offender rates more than one standard deviation above this mean offender rate were categorised as high-risk, while those clusters that exhibited offender rates more than one standard deviation below the mean offender rate were categorised as low-risk. Figure 3 shows the spatial pattern for the cluster solution categorised by risk.
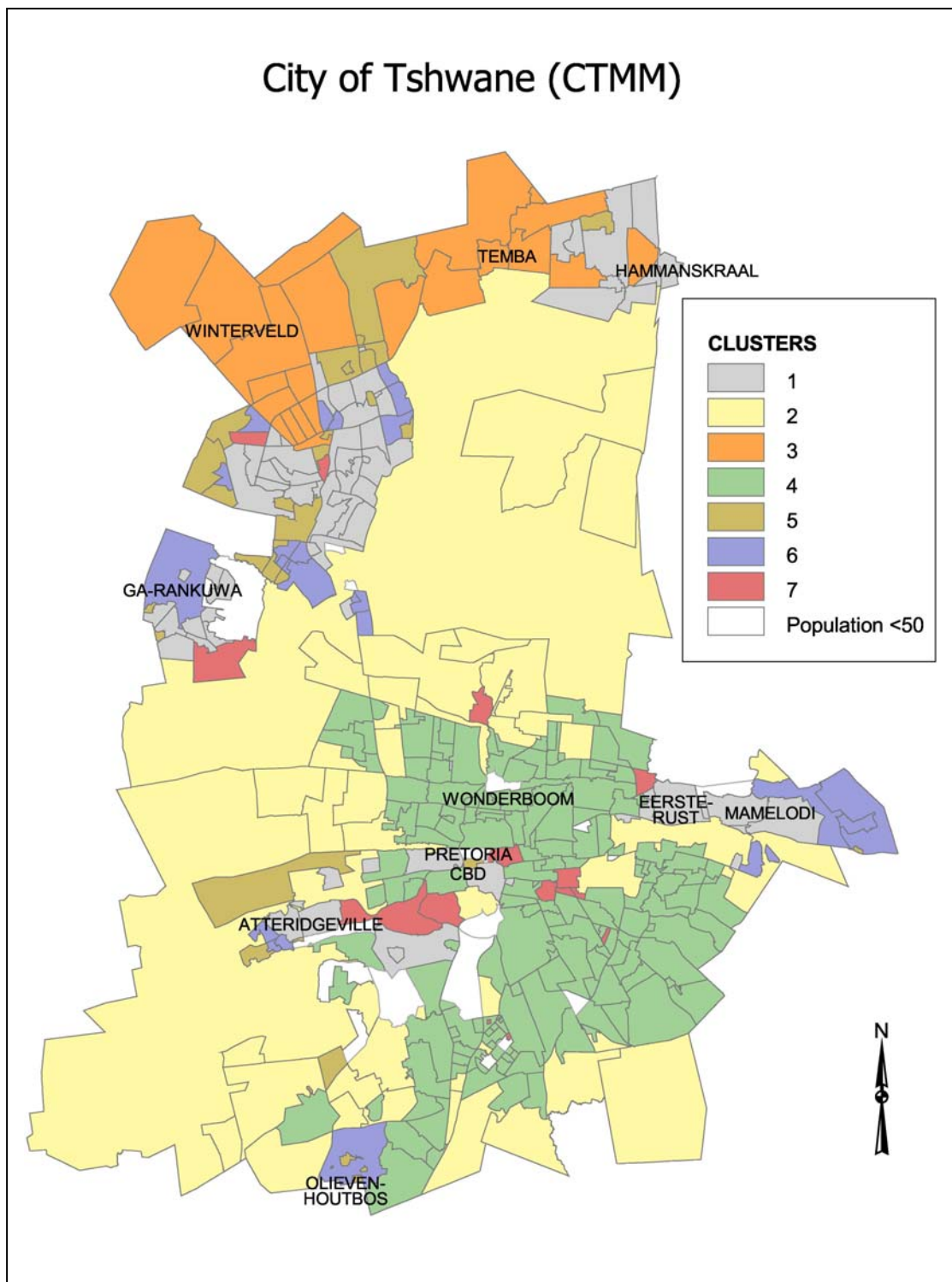
Figure 2: Spatial distribution of the seven clusters within the Tshwane municipality

Table 3:   Characteristics of the offender index and factors across the 7 clusters

	Cluster							
All suburbs	1	2	3	4	5	6	7	
$n = 354$	64	43	22	159	27	24	15	
Factors	Mean	Mean	Mean	Mean	Mean	Mean	Mean	F^a d.f. = [6,347]
Socio-economic status	-0.57	0.45	2.12	-0.51	1.73	0.36	-0.58	178
Family characteristics	1.13	-1.03	0.48	-0.31	0.70	1.49	-1.28	176
Unskilled earner	0.69	1.10	-0.37	-0.70	-0.46	0.66	1.31	116
Ageing population	0.47	-0.91	1.86	-0.05	-0.53	-1.26	1.69	96
Residential mobility	0.12	0.42	-0.05	0.12	0.07	-0.12	-0.01	8
Offender Index[b]	1.64	0.31	2.26	0.33	2.03	1.42	0.70	

[a] ANOVA variance ratio, for $P = 0.001$, $F_{[6,347]} = 3.843$
[b] Index expressed as rate per 1000 population over 18 years of age
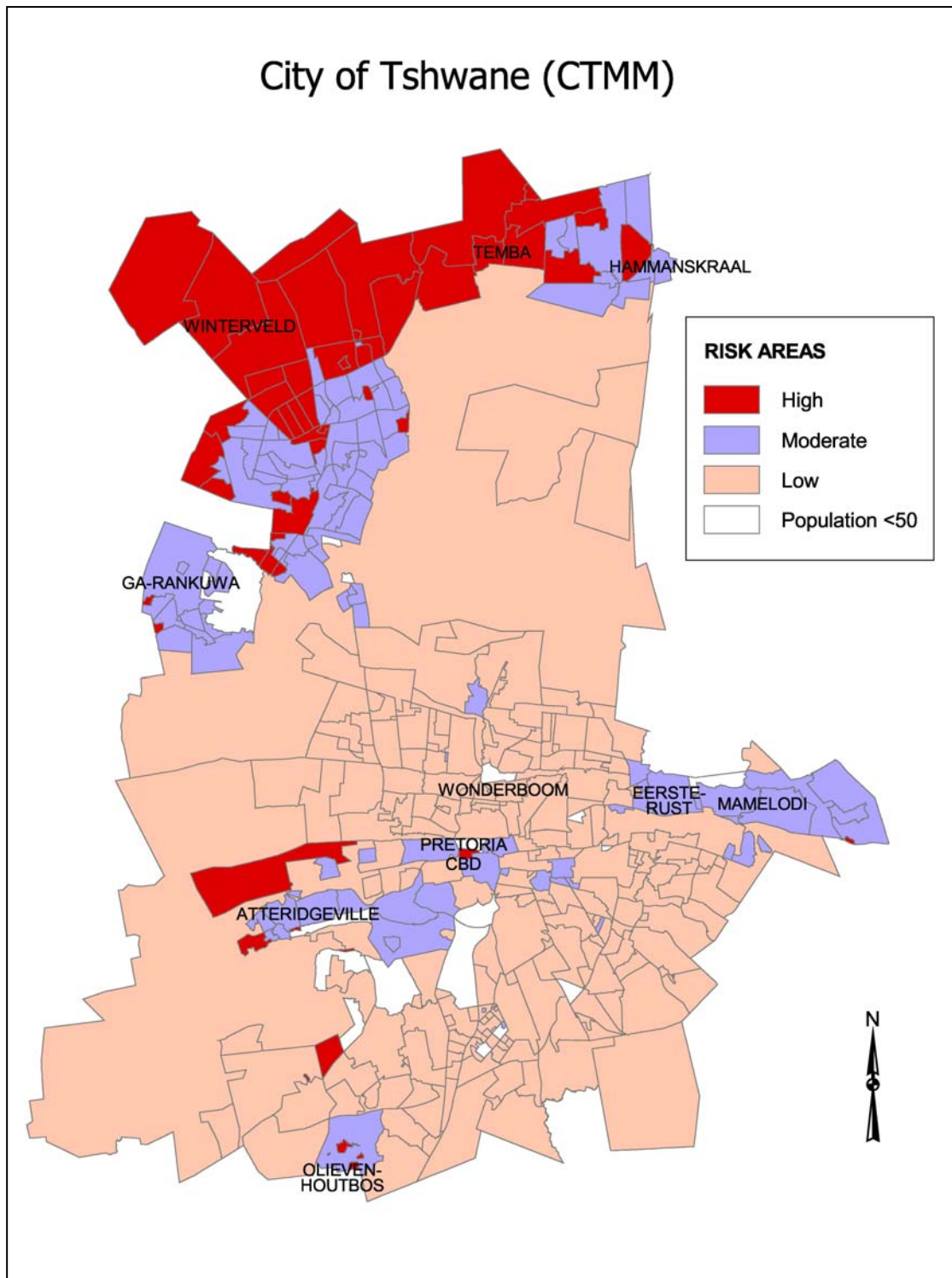
Figure 3:   Offender risk profiles for the Tshwane municipality

In the study, clusters 3 and 5 exhibited offender rates more than one standard deviation above the mean offender rate and are categorised as high-risk. Cluster 3 exhibited the highest mean offender rate and is primarily located in the common black African townships of Marokolong, Sekampaneng and Winterveld in the far northern regions of the municipality near the border with the North West province. The suburbs in this cluster are among the poorest and most deprived in the municipality with residents being predominantly unemployed and with numerous young dependents. Cluster 5 exhibited the second highest mean offender rate. The cluster again occurs predominantly in the far northern region of the municipality with only a few exceptions. These exceptions include the CBD, the informal extension of Atteridgeville, the Olifantsfontein informal node in the south, and a large but low-density cluster of impoverished whites just north of Atteridgeville. Residents in the northern region of this cluster are typically unemployed with low income and lack of basic amenities such as electricity and refuse removal.

Clusters 2 and 4 exhibited offender rates less than one standard deviation below the mean rate and are characterised as low-risk. Cluster 2 exhibited the lowest mean offender rate and is almost entirely located in outlying low-density areas and in the low-density area between the core city and the former homeland border townships. These suburbs are typically commercial properties used for the large-scale manufacturing and production of machinery and goods. Residents in these suburbs tend to be employed by these plants and factories and earn minimum wages. Suburbs in cluster 4 largely represent formerly white residential areas to the north, east and south of the inner city. Residents are typically employed with middle to high socio-economic status.

The remaining clusters 1, 6 and 7 were categorised as moderate risk. The suburbs in cluster 1 include the black African townships of Mamelodi, Atteridgeville and Temba-Hammanskraal. The population is characterised by employed residents in an unskilled occupation but with a modest provision of basic services. Cluster 6 displays a dispersed pattern with suburbs in varying regions of the municipality. The population is characterised by economically active residents but with disrupted families. Most households are formal dwelling units with a decent provision of basic services and relatively low mobility. And lastly, cluster 7 is mainly situated in and around the CBD of the Tshwane municipality with typically younger residents being employed but with moderate socio-economic status.

DISCUSSION

The categorisation of suburbs in South Africa is a minefield for the unwary. In a country whose recent political history is steeped in social segregation, discrimination and community fragmentation (Emmett, 2003), the identification of 'riskier' suburbs will necessarily come under immense scrutiny. While the susceptibility map shown in Figure 3 is to some extent based on subjective assessments, the difference in risk factors between geodemographic classes, outlined in Table 3, provides evidence that certain categories of suburbs are in fact different and that perhaps these differences affect offender propensity. The results of the study are investigated in terms of first, the racial structure of South African society and second, in terms of its assessment of past and present crime reduction policy initiatives.

A racial interpretation of the profiling system

A racial breakdown of the offender risk profiles for suburbs within the Tshwane municipality is provided in Table 4 supplemented with the racial breakdown of the municipality as a whole.

Table 4:   Racial distribution within the profiling system

n = No of suburbs	Total 354	High Risk 49	Moderate Risk 103	Low Risk 202
% Black African	52.89	98.61	85.39	26.48
% White	42.63	0.34	11.73	70.17
% Coloured	1.37	0.31	2.05	1.28
% Indian or Asian	1.50	0.74	0.83	2.07

A total of 49 suburbs within the Tshwane municipality are categorised as being at a high risk for offender development. These 49 suburbs (13.8% of the suburbs of Tshwane) occur predominantly on the northern border of the municipality and account for almost half of the offenders within Tshwane. The geodemographic groups classified as high-risk are mainly characteristic of the former black African homeland towns originating from forced removal policies instigated by the former apartheid government (Emmett, 2003). Distinct socio-demographic factors are associated with these high-risk groups including low socio-economic status, low income and a disrupted family. Also interesting to note in Table 4 is the overrepresentation of the black African population group among the high-risk suburbs. According to the classification system, almost 99% of the residents living in suburbs at a high-risk for offender development are black African. This contrasts sharply with the racial distribution of residents living in low-risk suburbs, where 70% of the residents are white and only 26% are black African. The racial stigma that is often attached to

crime in South Africa (see Allen, 2002) needs to be re-evaluated enlight of these findings which highlight the fact that patterns of racial and spatial inequality linked to levels of offending are strongly interconnected. Compared to predominantly white areas, black African suburbs have higher levels of socio-economic disadvantage, residential instability and disrupted families. The Coloured and Indian populations are also over-represented in the moderate and low risk areas, respectively, despite their low population numbers, a finding that warrants future attention. Krivo *et al*. (2006) has found that racial segregation isolates less well-off communities and can leave them vulnerable to neglect, discrimination, and other ill social forces. When the racial segregation is first, steeped within the historical and ethnical context that is South Africa, and second, to the extreme detriment of certain races, then the result can ostentatiously display itself through crime.

Crime planning and policy implications

The results of the study are supportive of a hybrid approach to crime reduction strategy in which the crime prevention approach of the former NCPS is combined with the law enforcement approach of the current NCCS. Clusters exhibiting high-risk for offender development were shown to be amongst the most socially and economically deprived in the Tshwane municipality. The current policy initiative that is tasked with reducing crime in the country, the NCCS, is not addressing these social conditions of offender risk however but rather focuses on enforcing the law (Leggett, 2004a). The findings of the study support du Plessis and Louw (2005) who contend that the biggest gap in South Africa's crime reduction effort is the area of social development. Whereas in the past local crime prevention initiatives concerned with the offender were dealt with by law enforcement and judicial system sectors

(Liebermann, 2002), this study suggests that other public sectors such as social development and education have an important role to play as well. Future crime reduction strategies should therefore include aspects of the current law enforcement approach to reduce the short-term crime levels, while also incorporating various crime prevention measures aimed to address the long-term social conditions in key regions of the city. While Leggett (2004b) focuses more on social intervention through by-law regulations, the authors explicitly propose an increase in the provision of basic amenities, improved public service delivery as well as the construction of various social infrastructures such as schools and hospitals. Such a strategy will ideally require a holistic perspective and inter-departmental cooperation.

CONCLUSION

Geodemographic classifications are key decision-making tools for the advancement and planning of local service delivery strategies including crime reduction. This study has shown how geodemographic analysis can not only highlight suburbs 'at-risk' for offender development but can also provide an additional spatially based platform from which to address derelict conditions within the Tshwane municipality. This could occur through the targeting not only of suburbs with known high offender rates but also of suburbs in the same geodemographic group, for whom offender risk is low. Whereas in the past the South African association between criminality and prevailing social conditions was either inferred from international research or loosely based on aspatial studies (see Brown, 2001; Mistry and Dhlamini, 2001; Demombynes and Özler 2005; Hodgskiss, 2004), this study provides, for the first time in a local context, a definitive geographic link between the location of offenders and the presence of

social and economic deprivation. The implications are significant. First, the research provides undisputable spatial evidence for the critical re-assessment of the current police-based crime reduction strategy and its replacement by a more balanced hybrid approach. The present narrow focus of the NCCS with its focus on law enforcement is inappropriate in South Africa given the fact that neighbourhoods with poor social conditions are shown in this study to be such significant determinants of offender development. Second, the disproportionate representation of the black African population in the identified high-risk suburbs also highlights not only the racial divisions that still characterises South African society and the failure of the present administration to address these, but more importantly the need to concentrate general social crime prevention initiatives in predominantly black African areas in the city. Offender-based geodemographic research in South Africa should be extended and in future also refine the differentiation between major crime types as well as involve more in-depth investigations into the rates of offending related specifically to individual racial and ethnic groups in the country. Furthermore, ecological theories of crime such as the social disorganisation theory should be applied at a neighbourhood level within a local context in order to evaluate its effectiveness in a society as segregated and racially diverse as South Africa.

ACKNOWLEDGEMENTS

REFERENCES

Allen, D.B. 2002. Race, crime and social exclusion: a qualitative study of white women's fear of crime in Johannesburg. *Urban Forum*, 13, 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.

Ashby, D.I. 2004. Geodemographics for policing: A new approach to the analysis of geographic variations in crime and policing performance. Paper presented at the 7th International Crime Mapping Research conference, Boston.

Ashby, D.I. and Longley, P.A. 2005. Geocomputation, geodemographics and resource allocation for local policing. *Transactions in GIS*, 9, 53–72.

Ballas, D., Kalogeresis, T. and Labrianidis, L. 2003. A comparative study of typologies for rural areas in Europe. Paper presented at the 43rd European Congress of the Regional Science Association, Jyväskylä, Finland.

Berg, J. and Schärf, W. 2004. Crime statistics in South Africa 1994-2003. *South African Journal of Criminal Justice*, 17, 57-78.

Bottoms, A. and Wiles, P. 2002. Environmental criminology and crime. In Maguire, M., Morgan, R, and Reiner, R. (Eds), *The Oxford Handbook of Criminology, 3rd Edition*. Oxford University Press: Oxford, 620-657.

Brantingham, P.J. and Brantingham, P.L. 1991. *Environmental Criminology*. Prospect Heights: Waveland.

Breetzke, G.D. and Horn, A.C. 2006. Crossing the racial divide: a spatial-ecological perspective of offenders in the City of Tshwane Metropolitan Municipality, South Africa. *GeoJournal*, 67, 181-194.

Brown, K.V. 2001. The determinants of crime in South Africa. *The South Africa Journal of Economics*, 69, 269-299.

Brown, P. and Batey, P. 1994. Design and construction of a geodemographic targeting system: Super Profiles 1994 WP-40, Urban Research and Policy Evaluation Regional Research Laboratory, Department of Civic Design, University of Liverpool, Liverpool.

Bukenya, J.O. 2005. Crime trends and socio-economic interactions: a county-level analysis. *Criminal Justice Studies*, 18, 365-378.

Cahill, M.E. and Mulligan, G.F. 2003. The determinants of crime in Tucson, Arizona. *Urban Geography*, 24, 582-610.

Carmichael, F. and Ward, R. 2000. Youth unemployment and crime in the English regions and Wales. *Applied Economics*, 32, 559-571.

Clarke, R.V. 1995. Situational crime prevention. In Tonry, M. and Farrington, D.P. (Eds), *Building a Safer Society: Strategic Approaches to Crime Prevention*. University of Chicago Press: Chicago, 91-150.

Cohen, L. and Felson, M. 1979. Social change and crime rate trends: a routine activity approach. *American Sociological Review*, 44, 588-08.

Copus, A. 1996. A rural development typology of European NUTS III regions, Working Paper 14, Agricultural and Rural Economics Department, Scottish Agricultural College, Aberdeen.

Coulton, C.I., Korbin, J., Chow, I. and Su, M. 1995. Community level factors and child maltreatment rates, *Child Development*, 66, 1262-1276.

Crutchfield, R.D., Geerken, M.R. and Gove, W.R. 1982. Crime rate and social integration: the impact of metropolitan mobility. *Criminology*, 20, 467-478.

Curry, D. 1993. *The New Marketing Research Systems: How to use Strategic Database Information for Better Marketing Decisions*. John Wiley & Sons: New York.

Debenham, J., Clarke, G. and Stillwell, J. 2001. Deriving supply-side variables to extend geodemographic classification. Working paper, School of Geography, University of Leeds, Leeds.

Debenham, J., Clarke, G. and Stillwell, J. 2003. Extending geodemographic classification: a new regional prototype. *Environment and Planning A*, 35, 1025–1050.

Demombynes, G. and Özler, B. 2005. Crime and local inequality in South Africa. *Journal of Development Economics*, 76, 265-292.

Du Plessis, A. and Louw, A. 2005. Crime and crime prevention in South Africa: 10 years after. Paper presented at the 14th World Conference on Criminology, Philadelphia.

Emmett, T. 2003. Social disorganisation, social capital and violence prevention in South Africa. *African Safety Promotion Journal*, 1, 4-18.

Ernst, J.S. 2001. Community-level factors and child maltreatment in a suburban county. *Social Work Research*, 25, 133-142.

Evans, D.J. 1980. *Geographical Perspectives on Juvenile Delinquency*. Gower: UK.

Fajnzylber, P., Lederman, D. and Loayza, N. 2002. What causes violent crime? *European Economic Review*, 46, 1323–1356.

Fisher, W. 1958. On grouping for maximum homogeneity. *Journal of the American Statistical Association*, 53, 789-798.

Glanz, L. 1996. The causes of crime in South Africa. Paper presented at the CRIMSA International Conference on Crime and Justice in the Nineties, Pretoria.

Gouws, A. 2004. The impact of crime on the legitimacy of the South African political system. *Acta Criminologica*, 17, 78-89.

Grant, D.S. and Martinez, R. Jr. 1997. Crime and the restructuring of the U.S. economy: a reconsideration of the class linkages. *Social Forces*, 75, 769–799.

Harper, G., Williamson, I., Clarke, G. and See, L. 2002. *Family Origins: Developing Groups of Crime and Disorder Reduction Partnerships and Police Basic Command Units for Comparative Purposes*. Home Office: London.

Harris, R., Sleight, P. and Webber, R. 2005. *Geodemographics, GIS and Neighbourhood Targeting*. John Wiley & Sons: Chichester.

Herbert, D. 2002. Crime and its control in urban environments. In Davis, W.K.D. and Townshend, I. (Eds), *Monitoring Cities: International Perspectives*. IGU Urban Commission: Berlin and Calgary, 541-556.

Hodgskiss, B. 2004. Lessons from serial murder in South Africa. *Journal of Investigative Psychology and Offender Profiling*, 1, 67-94.

Kawachi, I., Kennedy, B.P. and Wilkinson, R.G. 1999. Crime: social disorganisation and relative deprivation. *Social Science and Medicine*, 48, 719-731.

Krivo, L.J., Peterson, R.D. and Payne, D.C. 2006. Inequality in crime across place: exploring the role of segregation. Paper presented at the Annual Meeting of the Population Association of America, Los Angeles.

Labuschagne, G. 2003. Offender profiling in South Africa: It's definition and context. *Acta Criminologica*, 16, 67-74.

Leggett, T. 2004a. The state of crime and policing. In Daniel, J., Southall, R. and Lutchman, J. (Eds), *State of the Nation: South Africa 2004-05*. HSRC Press: Pretoria, 144-176.

Leggett, T. 2004b. By-laws and regulations for high impact crime prevention: why wait? *SA Crime Quarterly*, 8, 11-16.

Leigh, A., Arnott, J., Clarke, G.P. and See, L. 2000. *Family Values: Similar Policing and Crime Reduction Areas for Comparative Purposes*. Home Office: London.

Liebermann, S. 2002. Rethinking the role of planning: crime, the place and collaborative governance. Paper presented at the Planning Africa 2002 Conference, Durban.

Lockwood, D. 2004. Mapping violent crime in Savannah's neighborhoods, 1993-1997: social disadvantage, land use, and violent crimes reported to the police. Paper presented at the 8th International Crime Mapping Research Conference, Boston.

Logan, J.R. and Messner, S.F. 1987. Racial residential segregation and suburban violent crime. *Social Science Quarterly*, 68, 510-527.

Marais, C.W. 2003. Metro policing: too high a price? *Acta Criminologica*, 16, 138-150.

Mayhew, P., Maung, N.A. and Mirlees-Black, C. 1993. *The British Crime Survey*. Home Office: London.

Mistry, D. 2004. National victims of crime survey: falling crime, rising fear *SA Crime Quarterly*, 8, 17-24.

Mistry, D. and Dhlamini, J. 2001. Perpetrators of farm attacks: an offender profile. Unpublished report for the Institute for Human Rights and Criminal Justice Studies, South Africa.

Mokonyane, N.P. 2000. ANC daily news briefing by the Gauteng provincial Minister for Safety and Security. Available at: http://www.anc.org.za/anc/newsbrief/2000/news1019.txt, last accessed on 25 June 2007.

Naudé, B. 2000. The South African National Crime Prevention Strategy: a critique. *Acta Criminologica*, 13, 1-11.

Oh, J-H. 2005. Social disorganizations and crime rates in U.S. central cities: toward an explanation of urban economic change. *The Social Science Journal*, 42, 569-582.

Openshaw, S. 1995. *The Census Users' Handbook*. GeoInformation International: Cambridge.

Ovens, M. 2003. A criminological approach to crime in South Africa. *Acta Criminologica* 16, 67-80.

Pelser, A. and de Kock, C. 2000. Violence in South Africa: a note on some trends in the 1990s. *Acta Criminologica*, 13, 80-94.

Pelser, E. and Louw, A. 2002. Where did we go wrong? A critical assessment of crime prevention. *SA Crime Quarterly*, 2, 1-4.

Peterson, R.D., Krivo, L.J. and Harris, M.A. 2000. Disadvantage and neighborhood violent crime: do local institutions matter? *Journal of Research in Crime and Delinquency*, 37, 31-63.

Sampson, R. J. 1992. Family management and child development: Insights from social disorganization theory. In McCord, J. (Ed.), *Facts, Frameworks and Forecasts: Advances in Criminological Theory*. Transaction Publishers: New Brunswick, 63-93.

Schönteich, M. 2005. Murder in South Africa: What we know and don't know. Paper presented at the New Decade of Criminal Justice in South Africa: Consolidating Transformation Conference, Gordon's Bay.

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

Shaw, C.R. and McKay, H.D. 1942. *Juvenile Delinquency and Urban Areas*. University of Chicago Press: Chicago.

Sheldon, G., Hall, R., Brunsdon, C., Charlton, M., Alvanides, S. and Mostratos, N. 2002. Maintaining basic command unit and crime and disorder partnership families for comparative purposes. Available at: http://www.homeoffice.gov.uk/rds/pdfs2/basiccommand.pdf, last accessed 25 June 2007.

Shihadeh, E.S. and Flynn, N. 1996. Segregation and crime: the effect of black social isolation on the rates of black urban violence. *Social Forces*, 74, 1325-52.

Simcha-Fagan, O. and Schwartz, J. 1986. Neighbourhood and delinquency: An assessment of contextual effects. *Criminology*, 24, 667-704.

Simpson, G. and Rauch, J. 1999. Reflections on the National Crime Prevention Strategy. In Maharaj, G. (Ed.), *Between Unity and Diversity*. David Philip Publishers: Cape Town, 295-314.

Sleight, P. 1997. *Targeting Customers: How to use Geodemographics and Lifestyle Data in your Business*. NTC Publications Limited: Henley-on-Thames.

Sleight, P. 2004. An introductory review of geodemographic information systems. *Journal of Targeting, Measurement and Analysis for Marketing*, 12, 379-388.

Smith, D.R. and Jarjoura, C.R. 1988. Social structure and criminal victimization. *Journal of Research in Crime and Delinquency*, 25, 27-52.

South Africa. 1996. National Crime Prevention Strategy. Pretoria, South African Department of Safety and Security.

Vickers, D.W., Rees, P. and Birkin, M. 2005. Creating the National Classification of census output areas: data, methods and results. Working paper 05/2, School of Geography, University of Leeds, Leeds.

Vickers, D.W. 2006. Multi-level integrated classifications based on the 2001 Census. Unpublished PhD Thesis, School of Geography, University of Leeds, Leeds.

Weir-Smith, G. 2004. Crime mobility: spatial modelling of routine activities of arrestees and substance abusers in South Africa. *GeoJournal*, 59, 209-215.

Williamson, T., Ashby, D.I. and Webber, R. 2005. Young offenders, schools and the neighbourhood: a new approach to data-analysis for community policing. *Journal of Community and Applied Social Psychology*, 15, 203-28.

Williamson, T., Ashby, D.I. and Webber, R. 2006. Classifying neighbourhoods for reassurance policing. *Policing and Society*, 16, 189-218.