

A spatial analysis of crime in Brandon, Manitoba

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Abstract: Crime analysis has become a prominent subject within social geography. This study involves the analysis of crime data as well as socioeconomic data gathered for Brandon, Manitoba. Crime is broken down into personal crimes and property crimes. It was hypothesized that there is a significant correlation between the socioeconomic indicators of education and income levels with crime levels. Crime statistics were received from the Brandon Police Service for 1996 in order to allow comparison with the 1996 census data, the most recent data available at the time of the study. Through the use of a correlation analysis it was determined that correlations did in fact exist between education levels, income levels and personal and property crime levels. In addition, surveys of respondents' perceptions of crime within Brandon were shown to closely parallel those of the actual crime occurrences in the city. As a result of this research it is hoped to raise awareness and understanding among those interested in Brandon and in crime in small cities.

Key words: GIS, geography of crime, cognitive mapping, small cities, Brandon

Introduction

Crime analysis studies are not new to geography (Albaum 1973; Evans 1980; Georges 1978; Harries and Brunn 1978). In the mid-1960s Keith Harries used mapping techniques to determine that there were large spatial variations in the rates of crime committed in the United States, thereby establishing the foundation for modern geographic crime analysis (Harries 1974). Crime analysis has since become a common field of study within social geography, in both Canada and the USA, reflecting the significance of crime analysis and crime reduction in contemporary society (Getis *et al.* 2000; Sharpe 2000).

Crime analysis involves an analysis of past and present crimes, and the deduction of possible future trends based on detailed reports compiled by police departments. However, only in the past decade or so have these reports been available in digital format. This technical development, coupled with the improvement of specialized crime databases has meant

that very specific and detailed information has been kept on criminal incidents and offenders. These databases include information on the type of crime committed, the location of the crime, persons involved, time of day and day of week. Also associated with each incident reported is a unique identifier or incident number. The incident number allows for the easy retrieval of all information relevant to a specific crime and, along with its associated address, allows the police incident database to be linked to a map. Although there are still problems with the data sources, the ability to digitally record the geographic location of a crime and the associated attributes of that same incident has led to a shift from traditional methods of crime analysis toward the application of geographical information systems (GIS).

Despite the fact that law enforcement agencies are very diligent in their data collection, historically they have had little, if any, training in geography or GIS to aid in performing crime analysis. Traditionally, crime analysis by law enforcement officials involved the time consuming activity of plotting the location of crimes with pins on paper maps. It was then the task of detectives to determine possible patterns or trouble areas based upon their ability to visually interpret patterns produced by the pins. As such, crime analysis was a potentially biased and subjective process that relied heavily on the intuition of the detectives involved. Although useful results could be obtained, they typically varied with the personnel involved in each case.

Since the introduction and implementation of GIS, crime analysis has become an increasingly objective and analytical science. This more scientific approach has resulted in police forces becoming more proactive in their methods of community policing. With the coupling of current and historical data, police forces are able to forecast the contexts of criminal activity and react accordingly. Thus, computerized GIS provide increased efficiency and allow law enforcement agencies to address previously unanswered questions.

The following crime analysis study focuses on Brandon, Manitoba (Figure 1). Urban areas typically have higher rates of crimes than rural areas (Carter and Hill 1979; Sharpe 2000, 422). In addition, urban areas have demonstrated a significant spatial variation in the occurrences of crimes (Macionis and Spates 1982). Brandon is a small city with a population of approximately 40,000 people. Its small size means that the number of crimes committed, the volume of data collected by the Brandon Police Service, and the number of enumeration areas are manageable for purposes of this study. A number of problems do, of course, exist with

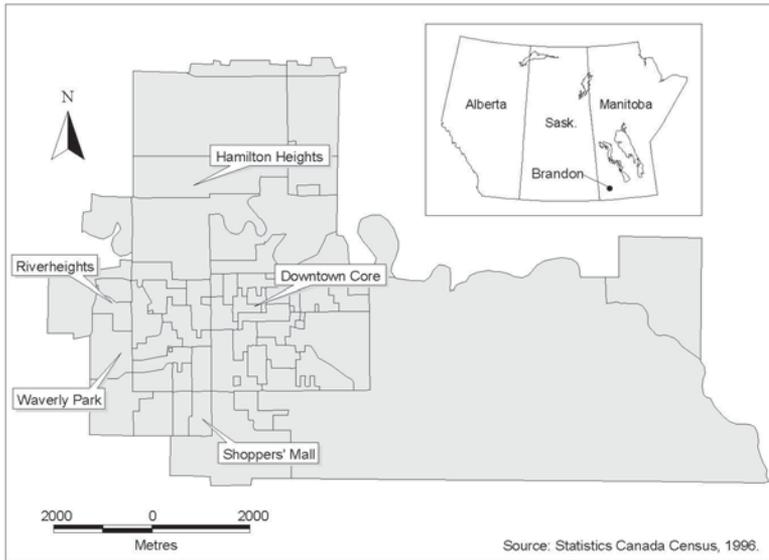


Figure 1: Enumeration areas and neighbourhoods in Brandon.

police data that can limit the analysis and even mask important patterns – as Harries pointed out many years ago “crime statistics are at best an approximation of the true crime situation” (1974, 4). For example unreported crimes, repeat victimization, multiple crimes and policing variations can cause distortions in the information available, and mean that the utmost caution is necessary in interpreting and explaining the resulting spatial patterns.

This study addresses two aspects of crime in Brandon. The first involves a comparison of 1996 census data, and crime data collected for the same period by the Brandon Police Service. Two hypotheses were formulated. The first was suggested by the work of Stahura and Huff (1979) who found that the higher the low-income population of a suburb, the greater the incidence of both violent and property crimes. This led to the generation of a hypothesis that “*crime rates of Brandon will have a negative correlation with income levels*”. That is, as the income level of an area decreases the corresponding crime rate for that area will increase.

The second hypothesis is related to levels of education, which Macionis and Spates (1982) have related to occurrence of crime. They

suggest that many poor or near-poor people, having restricted educational backgrounds and thus more limited job-training opportunities, may seek to supplement their incomes by turning to crime. Following this line of reasoning it was hypothesized that “*crime rates of Brandon will have a negative correlation with education levels*”. That is, the crime rate will increase as the level of education decreases. Although these hypotheses were based upon literature that refers to large metropolitan areas, prior knowledge of the urban geography of Brandon, as well as discussions with members of the Brandon Police Service suggested that they would also be applicable to the smaller urban context of Brandon.

The second aspect of this study involves an evaluation of the way that people perceive the occurrence of crime in Brandon and compares it to the actual occurrence of criminal activity. Perceptions of crime, as obtained from survey results, were used to develop cognitive maps that might aid in the understanding of crime and how it relates to other forms of spatial behaviour in Brandon. One hypothesis was formulated, namely, that the “*residents of Brandon will indicate the downtown core area of the city as having the highest rates of crime*”.

A survey was used to collect data on respondents’ perceptions of areas of high and low rates of crime, as well as background socio-economic data including income levels, and education levels. Perceived areas of high and low rates of crime, as indicated by the survey results, were digitized in order to allow their incorporation into a GIS. From these maps ‘hot areas’, or areas of perceived high crime rates, and ‘cool areas’, or areas of perceived low rates of crime were indicated.

Methodology

Five main areas of the research are discussed. First, the study area of Brandon and the enumeration areas that constitute the study area, are examined. The second section is concerned with the process of developing socio-economic maps based upon income and education levels, using data taken from the 1996 Canada Census data (Statistics Canada 1997). The third section discusses the design of crime maps and the construction of an appropriate crime index. The fourth section examines the processes involved in the production of cognitive maps of crime based on the survey responses. Lastly, a correlation analysis comparing average income, education levels, and property and personal crimes is presented.

Study Area

Brandon consists of sixty-two enumeration areas [EAs] (Figure 1) that constitute one Census Area (CA). However, not all EAs are equal in size, shape or socio-economic composition. An evaluation of the EAs enabled four categories to be developed based upon the relationship between each EA, and the neighbourhood-type that it was hoped to depict. The categories that were constructed included: 1) EAs consisting of institutions such as Brandon University, the Brandon Regional Health Authority hospital, and elderly persons' housing (EPH) complexes; 2) EAs that cross the boundaries of at least two of the traditional neighbourhoods; 3) EAs that have very irregular boundaries resulting in the inclusion of pieces of several neighbourhoods; and, 4) EAs that include sections of only one neighbourhood. The final category includes areas that are likely to be more homogeneous in terms of income and education levels — the two socio-economic variables used in this study. Consequently, only category four EAs were used for the sampling frame of this study.

The Development of Socio-economic Maps

One of the primary objectives of this study was to determine the validity of a hypothesized relationship between income and education levels, and the corresponding rates of crime at the EA level in Brandon. To facilitate this analysis, income and education levels, and the occurrence of crime were reduced to standardized indices. Once these indices had been determined it was possible to make an unbiased comparison between enumeration areas. The need for a comparison between enumeration areas resulted in maps of average income and education levels and the associated crime indices for each enumeration area. Figure 2 shows average household income in Brandon, and Figure 3 shows the percentage of people with post-secondary education. Although these two maps show largely similar distributions, there are some differences. For example, the lower household incomes are concentrated to a greater extent in Brandon's core area than are the lower educational levels. It was thus expected that the correlations between these variables and the crime data would differ to some degree. These two sets of data were derived from the 1996 census (Statistics Canada 1997).

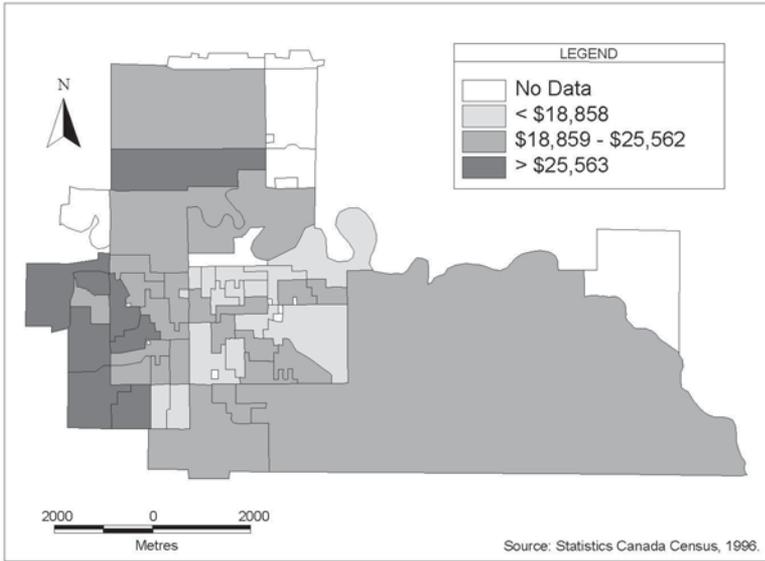


Figure 2: Average 1995 household income.

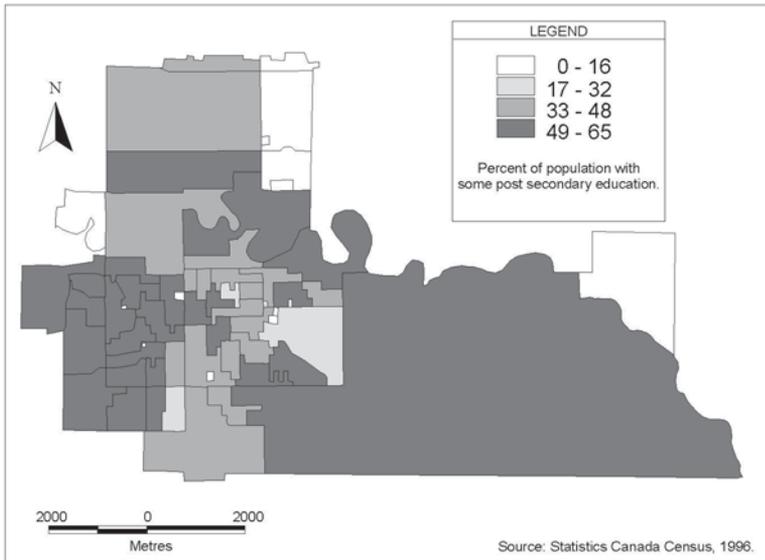


Figure 3: Post secondary education levels.

The Development of Crime Maps

In order to compare the income and education levels across Brandon with the crime rate, a crime index was determined. The crime index used was designed to take into account the number of crimes committed as a function of the population of the enumeration area. As it was not practical to compare every category of crime with income and education levels, two broad categories of crime were used that reflected traditional usage in the literature (Carter and Hill 1979), and within the Brandon Police Service.

The first of these broad categories was termed ‘personal crimes’, and included assaults, sexual assaults and robberies. The second category used was called ‘property crimes’ and included arson, business and residential break and enter, fraud, theft of motor vehicles, theft under and over \$5,000, theft from vehicles, possession of stolen goods and mischief under \$5,000 (Brandon Police Service 2000). Data problems could, of course, result from the use of such broad categories of crime where the severity of crimes within these categories can be seen to vary considerably. However, it was felt that for this preliminary study of the geography of crime in Brandon, where comparisons with other jurisdictions were not critical to conclusions of the study, and where within-category distinctions were not being made, that the use of the traditional categories was appropriate for the type of analysis undertaken.

In the development of the crime index, two key components were used, namely the number of crimes committed, and the total population of the enumeration area. A crude comparison of the total number of crimes for each enumeration area would have led to results, particularly in the correlation analysis, that would have been difficult to interpret. Therefore, it was determined that a standardized crime index was more appropriate, even though this might exaggerate the incidence of crime in the core area, and understate the crime situation in the suburbs. This crime index (C_i) was defined as the total number of crimes per 100 of the population. Two unique crime indices, one for personal crimes ($C_i_{(personal)}$) and one for property crimes ($C_i_{(property)}$), were then calculated for each enumeration area, producing two maps (Figures 4 and 5).

The Development of Cognitive Maps

Within the survey there were two questions that specifically pertained to peoples’ perception of crime in Brandon. First, respondents were asked to “outline the one area that you feel has the highest rate of crime in

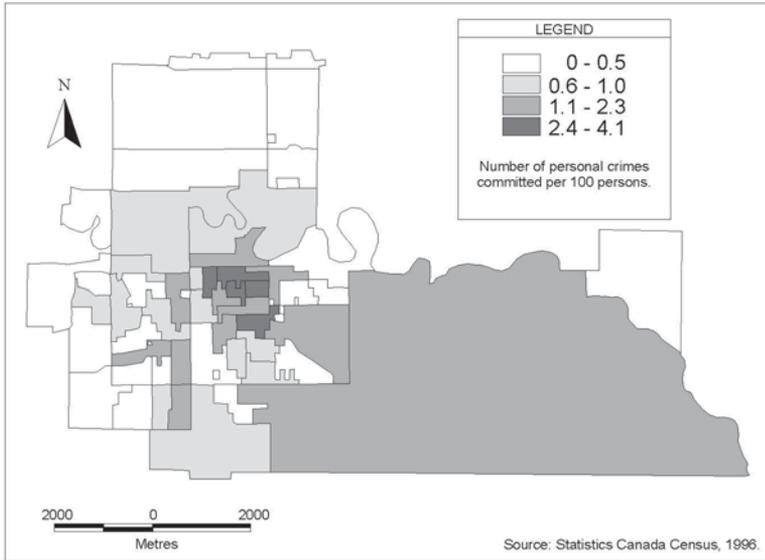


Figure 4: Personal crime index.

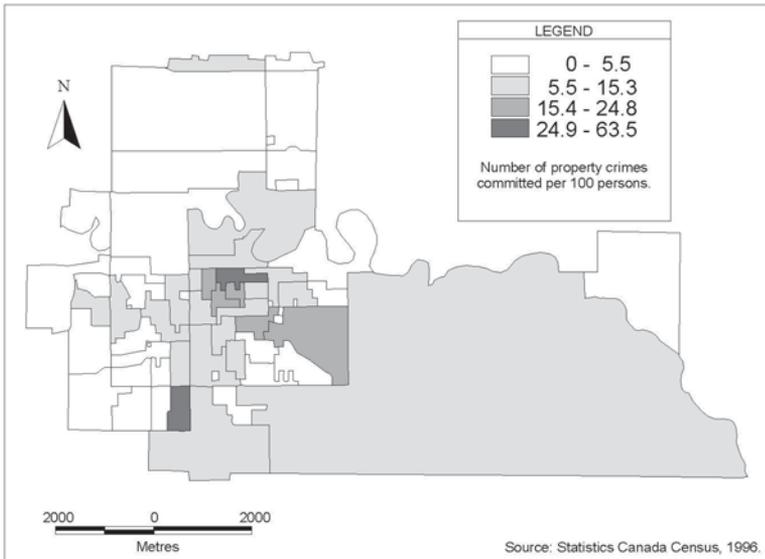


Figure 5: Property crime index.

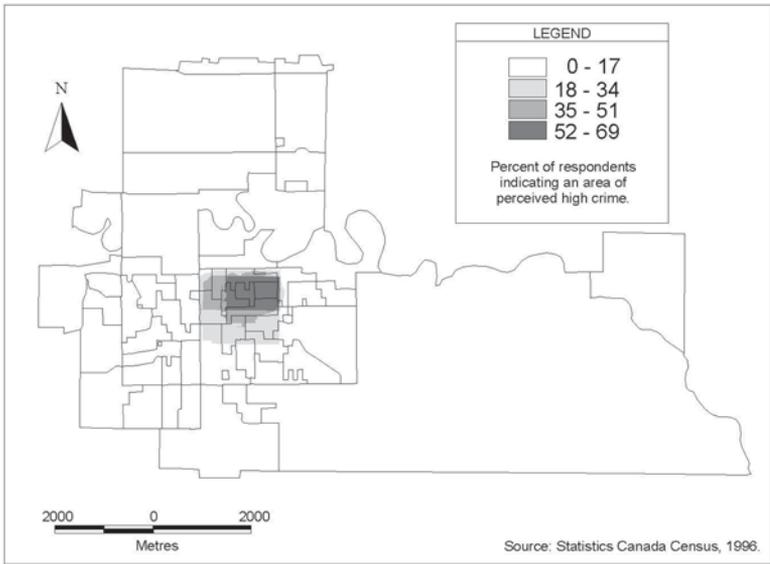


Figure 6: Perceptual areas of high crime rates.

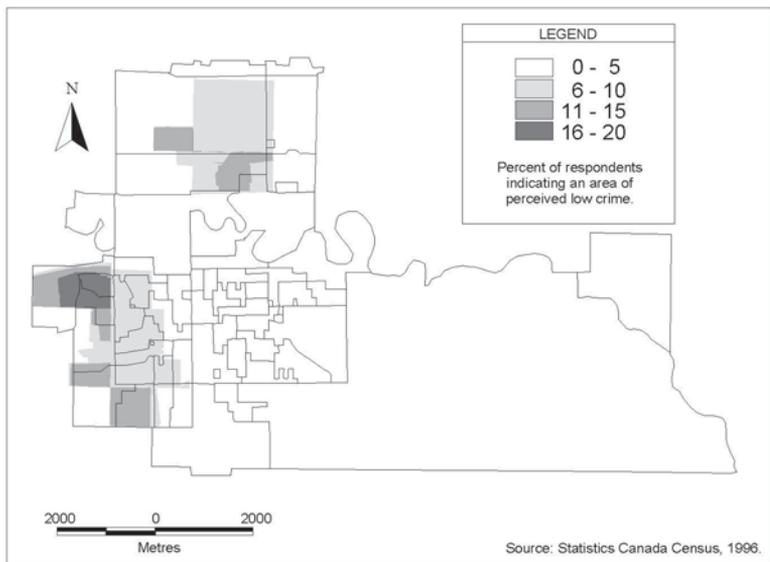


Figure 7: Perceptual areas of low crime rates.

Brandon”, and second, to “outline the area which you feel has the lowest rate of crime”. Once all the surveys had been compiled they were entered into a GIS to develop cognitive crime maps for Brandon (Figures 6 and 7)

Correlation Analysis

Once the survey data had been collected and evaluated, four Pearson’s Product Moment correlation coefficients were calculated using the derived crime index. The first two correlation analyses incorporated forty-six observations (N), and compared average household income with the property crime index ($CI_{(property)}$), and average household income with the personal crime index ($CI_{(personal)}$). The other two correlation coefficients incorporated forty-eight observations, and compared the percentage of the population with post-secondary education and the property crime index ($CI_{(property)}$), and the percentage of the population with post-secondary education and the personal crime index ($CI_{(personal)}$).

Results

The results section is divided into three major parts. The first section documents the responses of the surveys sent to 200 residents of Brandon. The second section deals with the correlation analyses, which analyzed the four major variables included in this study. The final section discusses the results that led to the construction of the cognitive crime maps.

Survey Responses:

A survey was mailed to 200 residents of Brandon chosen at random from across the city. Of the 200 surveys that were sent, 100 were returned. In addition to identifying hot and cold areas, respondents provided additional information through two additional questions, concerning their opinions about crime in Brandon. The first of these questions was “Do you feel that personal crimes or property crimes are the most prevalent crimes in Brandon?” It was included in order to assess the respondents’ knowledge of crime in Brandon. Of the 100 respondents to this question, 86% correctly judged that property crimes were the most prevalent, 12% felt that personal crimes were most common, and 2% did not respond. The second question was, “Do you feel that most criminals commit crimes in their own neighbourhoods or others?” It was included in order to further assess the perceptions of respondents. Of the 100 respondents to this

question, 36% felt that criminals committed crimes in their own neighbourhoods, 47% felt the majority of crimes were committed in others' neighbourhoods and 17% failed to respond. These results will be discussed later in the paper.

Correlation Analysis Results:

It should be noted that the identification of a relationship through correlation analysis does not necessarily mean that a causal relationship exists. That is to say, one variable is not necessarily dependent on the other variable. Any relationship identified by the correlation analysis simply indicates that the two variables react in the same fashion and determines whether the relationship is positive (an increase in one variable is associated with an increase in the second variable), or negative (an increase in one variable is associated with a decrease in the second variable).

The first two variables analyzed were the average household income and the property crime index. The calculated correlation coefficient for these variables was found to be -0.541, significant at the 0.01 level. This indicates that there is a strong inverse relationship between income levels and the derived property crime index. The next correlation evaluated the relationship between average household income and the personal crime index. A stronger inverse correlation was found with the resulting coefficient being -0.691, also significant at the 0.01 level. Thus, both the personal and property crime indices were found to have an inverse relationship with average household income. This supports the first hypothesis that "*crime rates of Brandon will have a negative correlation with income levels*".

The third correlation analysis evaluated the relationship between the percentage of the population with post-secondary education and the property crime index. Once more, an inverse correlation was found, with a correlation coefficient of -0.481. The last correlation evaluated the relationship between the percentage of the population with post-secondary education and the personal crime index. Again, an inverse correlation was found (-0.442). The latter two correlation coefficients were significant at the 0.01 level. This confirmed the second hypothesis of this study that "*crime rates of Brandon will have a negative correlation with education levels*". The weaker relationships involving education level are no doubt related to the differences in the distributions of income and educational levels within the city, and in particular, the more concentrated nature of the low income households in the core area.

Cognitive maps of crime rates:

It had been hypothesized that the “*residents of Brandon will indicate the downtown core area of the city as having the highest rates of crime*”. A qualitative analysis of the resulting cognitive maps appears to support this assertion. As can be seen in Figure 6, respondents identified the downtown core as having the highest rate of crime, with over two thirds of the respondents selecting this area. In addition, the second highest area indicated, with 42% to 55% response rates, was also found in the downtown core.

As Figure 7 shows, there are three major areas with perceived low crime rates in Brandon. The first can be found within the neighbourhood known as Riverheights in the west end of Brandon; the other two are found in the neighbourhoods of Hamilton Heights, on the north hill, and the Waverly Park subdivision in the west end. The larger number of cool areas identified accounts for the lower frequency of responses (with a high of about 17% compared to 55% for hot areas).

Cool areas were more widely distributed across the city, and some explanatory characteristics can be found when comparing them with the two socio-economic factors identified earlier. All of the cool areas are located in more affluent areas, with average annual incomes of \$24,597 and over, and high rates of post-secondary education. Conversely, the area identified as having the highest rate of crime, fell into both the lowest categories of income (\$17,573 or less) and post-secondary education (less than 42% of the population). Thus, the expected relationships between income and education levels, and crime rates, were observed in the cognitive maps of crime.

Conclusion

This study determined that there are statistically significant negative correlations between crime rates and both income and education levels. It was also demonstrated that the majority of Brandon residents identified the downtown core as the area with the highest rates of crime. Although this is a correct perception, the results of the survey indicated that the Brandon Shoppers (sic) Mall (Figure 1), also an area of high (property) crime, is not perceived as such by Brandon residents. This conclusion warrants further investigation, but it is likely a reflection of information received by the respondents — crime at the mall receives less ‘press’ than crime downtown. It may also reflect the fact that the mall is located in an

area with a higher socio-economic status, and such areas are, as the research found, not usually associated in the public mind with high levels of crime.

A more varied response was given to the question regarding areas of Brandon that have the lowest rates of crime. In this case, a number of areas were identified. All were affluent, suburban areas where crime rates might be low, but where the number of crimes might be much higher. Once again this response deserves further research, but also reflects the information available to the respondents from the press. It might also reflect the desire of some respondents to visualize their own neighbourhoods as safer and more crime free than other areas of the city.

Lastly, doubts remain concerning the validity of the results of such a preliminary study, and thus the insights that can be derived from these findings. For example, what exactly does a correlation between the crime rate and the socio-economic status of an area mean? It could mean that the areas of lower status harbour more criminals – and this would appear to be the belief of many of respondents in this study. On the other hand, *it could mean* that the residents of (for instance) the central area of the city are more easily victimized - by people who might live in (for instance) the suburbs of the city.

Consequently, this first geography of crime in Brandon must be seen for what it is — an attempt to begin to identify the challenges and prospects associated with the spatial analysis of crime data collected by the Brandon Police Service. The results indicate that from a crime perspective Brandon is similar to other Canadian and Anglo-American urban areas, and that generalizations made elsewhere can be used to interpret the general situation in the ‘Wheat City’. At the same time it is clear that further research has to take place at a finer scale in order to distinguish the characteristics that are particular to Brandon and to begin to provide solutions to the challenges of crime in the twenty-first century. It is hoped that studies such as this will encourage the use of geographical information systems in the recording and analysis of crime, and will contribute to improved crime detection and management practices within the Brandon Police Service.

Acknowledgements

We would like to thank the people who responded to our survey, and the City of Brandon and the Brandon Police Service for their help in data production and analysis.

Notes

1. Using data provided from the Uniform Crime Reports of the F.B.I., Harries produced crude maps to show the rates of eight common crimes committed throughout the United States.
2. It is interesting to note that a relatively new crime series on CBS TV, “The District” uses the ability to combine crime data with a GIS as a centre point of the shows.
3. Brandon has always been treated as one Census Area by Statistics Canada, even though its population of some 40,000 might justify its subdivision into a number of census tracts.
4. Enumeration Areas were designed to “be as compact as possible to minimize travel and optimize census representative work. EAs are delineated so that the census representative may locate them with as little difficulty as possible. Therefore, wherever possible, EAs follow easily recognizable physical features (such as the road network and rivers)” (Statistics Canada 1992, 191). That is to say, EAs were not defined with neighbourhood boundaries or socio-economic divisions in mind.
5. These neighbourhoods are based upon the socio-economic development and physical growth of Brandon over time. They are generally recognised by the long-term residents of Brandon, and were once mapped by the Real Estate Board. This map has since been updated by the Department of Geography at Brandon University as urban growth has extended Brandon’s built up area, and the latest version of this figure was used as a base map in this study.
6. Although this process of selection eliminated some problems from the sampling frame, it may have introduced others. For example, the exclusion of EPHs left out concentrations of elderly people who might experience, and perceive, crime differently to other age groups. However, the authors are confident that the sampling process that was used eliminated more problems than it created.
7. Although it is recognized that a map showing the absolute number of crimes might be quite different from one of crime rates - reflecting the different populations of the enumeration areas – the data available for this study was not in a form that could provide an accurate dot density map of crime counts. For this reason, as well as others discussed in the text, crime rates were mapped using a choropleth mapping technique.
8. Although there are sixty-two enumeration areas in Brandon, usable data are not available for all of these. Some areas have no permanent population, and others have numbers that are small enough to cause difficulties with respect to

confidentiality regulations. Forty-six or forty-eight EAs yielded usable data, depending upon the variable in question.

9. A 50% response rate was felt to be good for this kind of survey. The rate was probably improved by a story about the study that appeared in the local newspaper the Brandon Sun concurrently with the implementation of the survey.
10. Significant issues with this kind of analysis can arise from scale effects and the modifiable areal unit problem. These are not issues in this paper as both scale and areal units are constant in the present research design. It would, however, become an issue if comparisons to other studies and cases were to be made.
11. This conclusion is based upon the personal experiences and judgments of the authors. It was confirmed in conversations with media reporters.

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