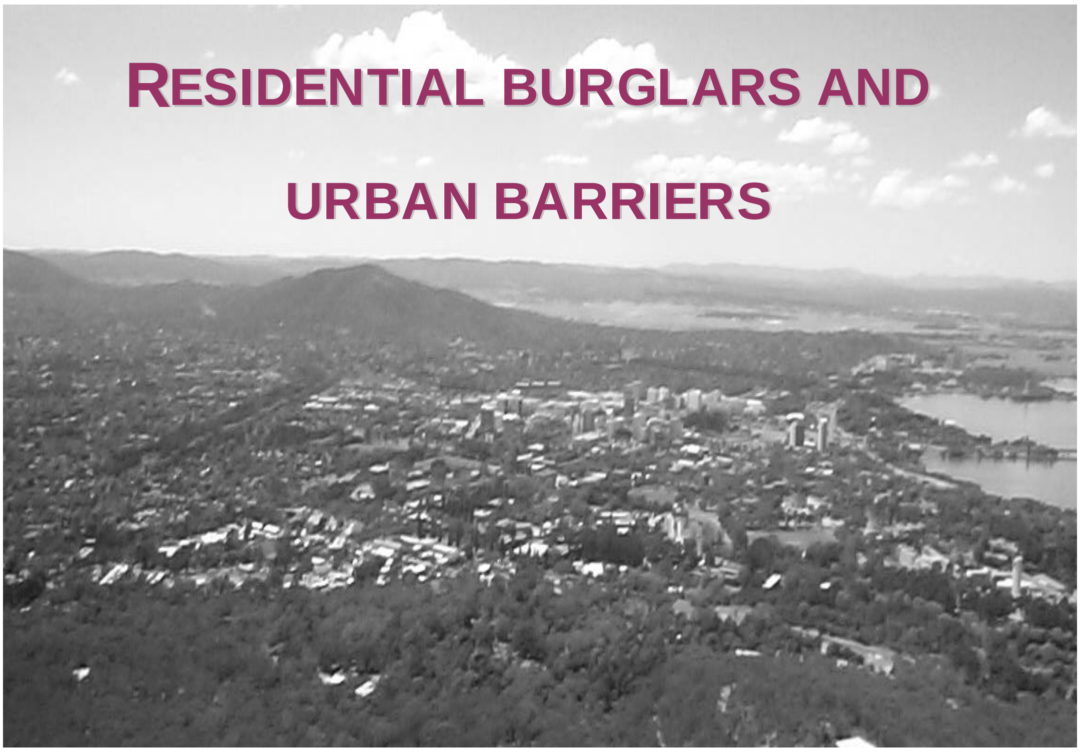
RESIDENTIAL BURGLARS AND URBAN BARRIERS



A QUANTITATIVE SPATIAL STUDY OF THE IMPACT OF CANBERRA'S UNIQUE GEOGRAPHY ON RESIDENTIAL BURGLARY OFFENDERS

FINAL REPORT

CRIMINOLOGY RESEARCH COUNCIL GRANT
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Contents

Executive summary

This study has investigated the question; 'Are offenders inhibited by suburb boundaries and urban barriers, such as major road systems and vegetation strips?' The study employed burglary and offender data for 1999 and 2000 supplied by the Australian Federal Police (ACT Region) for the city of Canberra, Australia. The journey-to-crime residential burglary patterns of 95 offender/offence records (from home address to targeted location) were plotted on a Geographical Information System (GIS) and compared to the actual locations of all houses within the same area. This was achieved using a new process for generating potential burglary targets in a GIS.

The results show that offenders are not inhibited in their travel plans, and there is no statistical evidence that offenders favour their own suburb over other suburbs that are within their travel range. For example, if an offender is prepared to travel (direct distance) 2 kilometres to commit an offence, and within that distance the offender might be able to access another suburb, there is no indication that offenders in Canberra deliberately choose to target a particular suburb (either their own or the neighbouring area). The statistical findings suggest that the Canberran burglars follow an expected distribution of target selection based on simple geographical opportunity that is unaffected by urban barriers.

Acknowledgments

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The author would also like to thank Philippa Ratcliffe, and Professor George Rengert of Temple University, Philadelphia, for reading the draft manuscript and contributing a number of invaluable suggestions. While all listed on this page have contributed positively to this final work, alas any errors and omissions remain all my very own.

Caveat

This paper includes an analysis of data made available by the AFP (ACT Policing) for a project supported by the Criminology Research Council (CRC 17/00-01). The views expressed are the responsibility of the author and are not necessarily those of the Council.

Introduction

This research project, with the full co-operation of the Australian Federal Police, has examined the behaviour of prolific property crime offenders (burglars) in relation to the urban geography of the Australian Capital Territory (ACT) and in particular the city of Canberra[1]. To be more specific, the purpose of the study was to discover if residential burglary offenders are influenced by the availability of potential targets in different suburbs to their home address. It is possible that the environmental and socio-economic barriers in urban spaces have an inhibitory effect on the rational choices made by offenders. This project did not aim to perform a qualitative analysis of intersuburb journey-to-crime patterns but to perform an exploratory quantitative[2] examination. Previous studies (discussed in the next section) have made a number of assumptions about the urban environment to simplify the analysis, and existing travel-to-crime models tend to be concentric. The disorganised nature of housing patterns in most urban environments makes more complex and advanced studies difficult. However housing density does change across suburbs. Natural features and urban parkland create areas within suburbs with no dwellings, and the existence of shops, schools and other non-residential structures can introduce a variation to the urban landscape that unsophisticated analyses fail to detect. The next section (Background and issues) will discuss the findings of previous studies and the theoretical limitations of these analyses.

Canberra was deliberately chosen as the study area for the current project. Studying intersuburb journeys of residential burglars requires a region where the boundaries between suburbs are clearly indicated, not just administratively but physically. The deliberate development of the city is evident in the structural layout of the majority of suburbs in the ACT. They have been developed in line with a number of metropolitan plans where suburbs

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[1] Although administratively different, the city of Canberra is to all intents and purposes the Australian Capital Territory and the terms are used interchangeably in this study.

[2] This study will not seek to replicate the qualitative investigations that have examined the decision-making processes of individual burglars. There are a number of studies currently underway that have asked convicted burglars about their choice of targets, but these are usually situational studies of specific locations, such as the existence of alarms or dogs on the premises. One such example is the recent report on burglaries in the ACT (Collins, 1999).

are planned many years in advance, often around the development of new towns rather than appended to existing settlements. The next section will also describe the history of urban development in Canberra, and the growth and decline of public housing in Canberra as they relate to this study.

This report will then describe the various data sets employed in the work (Methodology section). These data include digital maps of Canberra as well as offender and burglary data for the ACT, provided by the Australian Federal Police (AFP) from their PROMIS database. Limitations on the number of prolific offenders detected by the ACT Police[3] in the available data means this analysis will aggregate the behaviour of all offenders detected as a result of burglary investigations. This is a commonly used technique termed Aggregate Spatial Criminal Behaviour (Brantingham and Brantingham 1984). Included in this section is a summary of the general pattern of burglary and the demographics of burglars in the ACT.

The section on methodology will also describe the new techniques and approaches developed to complete a more complex quantitative spatial analysis on recidivist offending patterns.

Results of both the urban geographical and the journey to crime analyses are discussed in the Results section which describes in detail the statistical significance, where it exists, of the findings of the study.

The final summary section concentrates on the significance of the findings in relation to current environmental criminological thought by beginning with the implications for studying the geography of crime at a local level, and moving onto the impact of urban barriers on offenders. The impact on environmental criminology theory and the potential policy implications are also reviewed.

Finally, the stated aims of the project in the original grant application are reviewed in the light of the findings of this project, and areas of future research are considered.

[3] The AFP are responsible for policing the ACT, and the officers in this area are referred to in various locations as AFP (ACT Policing) or AFP (ACT region). This report will refer to ACT Police from this point onwards.

Background and issues

In the study of criminal behaviour over space, criminologists and geographers aim to understand the fundamental characteristics that explain offender spatial behaviour. This includes the study of offenders' perception of target availability in different areas, and distances criminals are prepared to cover to commit offences. These two areas of research (territoriality and journey-to-crime) are discussed here.

Territoriality

Taylor defines human territoriality functioning as "an interlocked system of attitudes, sentiments, and behaviours that are specific to a particular, usually delimited, site or location, which, in the context of individuals in a group, or a small group as a whole, reflect and reinforce, for those individuals or groups, some degree of excludability of use, responsibility for, and control over activities in these specific sites" (Taylor 1988). This suggests that if people have strong beliefs about areas and places, then their behaviour in relation to those areas is to some degree predictable. While Taylor is concerned with the face-to-face interactions at the street level between individuals, the process is applicable on a number of scales. Because territorial functioning is "highly place specific," the benefits or resources emerging from the territory vary according to the type of place. Smaller areas under the control of a smaller number of individuals are more likely to be viewed as territory to be protected by that control group. As the area under consideration grows, the extent of altruistic control diminishes.

Brown and Altman (1981) contend that the formation of the three types of territories (primary, secondary and public) is based on the need for privacy. They view privacy as a "dialectic boundary regulation" which involves a permeability to the social and physical environment. These boundaries are not only articulated physically through the use of hedges and fences, but are also expressed through verbal and non-verbal behaviour such as displays of personal decorations and cultural expressions near an individual's property.

These signals at an individual property level may exist in some collective form at a neighbourhood level, giving an indication to an outsider that this is a neighbourhood where people watch out for each other, and care about themselves and their neighbours. Alternatively it could be that these 'signals' from individual property markers (demonstrating 'territory') do not express themselves into group image of a neighbourhood and outsiders are free to assess each property on a site-by-site basis. As outsiders interact within a given location, place images and "territorial cognitions suggest, support, or justify particular territorial behaviours." Territorial cognitions shape routine or responsive behaviours and they link the consequences that occur on three levels - ecological, social psychological, and psychological. While a number of studies and theories, such as Defensible Space (Newman 1972), are concerned with deterring offenders from individual properties and sites, this study is interested in the impact on a burglar of moving from a home suburb to another suburb. The availability of other suburbs in which to offend is clearly relevant, as is the distance that offenders are prepared to travel in general to commit crime.

Existing journey-to-crime models

Modern 'journey to crime' [4] studies have their origins in the work of the Chicago School (Burgess 1916; Shaw and McKay 1942), and a number of recent studies at the macro level are still restricted by the concentric design of Burgess' zonal model (Burgess 1916). Like many contemporary models, the Burgess zonal model relies on high levels of aggregation to be predictive, but the travel patterns of individual offenders tend to be short distances, requiring a greater resolution of analysis. Intraurban studies of microlevel spatial patterns therefore require either a finer level of aggregation (Ouimet 2000), or a different approach altogether. When smaller scale studies are desired, individual patterns of residence-to-offence location must be examined. At this level human spatial behaviour becomes apparent and both criminals and non-criminals share well-established travel patterns (Brantingham and Brantingham 1984). People interact more with other people and things close to their home, and less so with objects further away. Just as we would probably not travel 20 miles for a litre of milk, so a criminal is unlikely to travel far to commit property crimes, unless closer opportunities do not present themselves. "Interactions decrease as distance increases (distance decay)" (Brantingham and Brantingham 1984 p.314).

[4] Also sometimes referred to as 'travel to crime'

More recent intraurban studies have noticed a pronounced decay effect where the majority of property-related crimes occur near the criminal's home address, and decay rapidly the further you get from the home address (Georges 1978; Brantingham and Brantingham 1981; Van Koppen and De Keijser 1997; Harries 1999; Rengert *et al.* 1999; Ouimet 2000). Another reason put forward for the decay effect in both adults and juveniles has been the suggestion of 'spatial awareness biases' (Cater and Jones 1992). This suggests a behavioural pattern whereby factors of distance and information are relevant. A criminal will confine his activity to known areas (generally the local environment) and is 'unlikely to penetrate into totally foreign areas where he will feel uncomfortable or stand out as different.' (Brantingham and Brantingham 1981, p.29). Evidence for this argument is compelling. A study in a Staffordshire town showed nearly 50% of detected burglaries were committed within 0.8kms of the perpetrators home (Cater and Jones 1992). The extensive Sheffield Crime Survey (Baldwin and Bottoms 1976) found three quarters of the city's burglaries to have been committed within 2 miles of the burglar's address. There are two components to this argument:

1. The number of crimes that an offender commits decreases with increasing distance from the offender's residence (least effort principle),

2. Offenders are not likely to venture into foreign areas where they will stand out. The Brantinghams have suggested that the familiarity of being in a known area will generally outweigh the risk of being recognised (Brantingham and Brantingham 1981).

As Maguire points out, a *caveat* to most of this research is that these studies are based (as is this report) upon detected offenders. "It may be that those who burgle close to home are easier to catch than those who travel from where they are known, thus exaggerating the extent of 'local' burglary" (Maguire 1982 p.27). This is a factor that should be considered, while also noting that there is no evidence to suggest that detected burglars are not broadly indicative of the general burglary-committing population.

As Canter and Larkin point out, building a theory of offender non-random target selection has first to be based on the hypothesis that offenders have a home base and are not itinerant drifters, and that offenders will have developed an environmental psychology model of their local area (Canter and Larkin 1993 p.63). Shaw and McKay suggested that if offenders work away from a fixed location (such as a city centre) then they are working outside of their personal experience and their behaviour is determined by other factors (Shaw and McKay 1942). For the purposes of the current study the target group for spatial analysis will be the residential burglars and their relationship between home address and target location. Of direct relevance to this study is the work of Rengert and Wasilchick. Their interviews of 31 burglars in the Philadelphia area demonstrated the importance of local non-criminal activities and day-to-day journeys in identifying the range of criminal opportunities later exploited by offenders (Rengert and Wasilchick 1985).

Canter and Larkin (1993) in their analysis of UK rapists proposed two general models based on the relationship between the home area of an offender (termed 'home range') and the area in which offences are committed (termed 'criminal range'). With the **commuter hypothesis**, an offender travels from the home range to a distinct area to commit offences that does not overlap (or has little overlap) with their home range. In this manner an offender is drawn to a non-home related area that they may have some relationship with, such as a city centre (known through recreational use) or a work environment (Canter and Larkin 1993 p.65). By contrast the **marauder hypothesis** suggests that the home base acts as the central axis for the pattern of offences. Compared to the commuter hypothesis there is now a near complete overlap of the home range and the criminal range with one (to some degree) dictating the range of the other. Although Canter and Larkin introduce these two models the individual behaviour of offenders is still dictated by distance as a frictional surface to be negotiated, and a desire to find a criminal range in which they do not feel unduly uncomfortable.

These two components of distance decay and suburban familiarity mentioned on page 8, while linked to the same general theory, are quite different. One is a function of distance (or perceived distance) and the amount of effort required to cross that distance. The second is a function of individual perception of the socio-economic characteristics of an area. Both distance and the characteristics of an area are related to urban geography, and as Sir Anthony Bottoms and Paul Wiles have pointed out, it is incomplete to arrive at an explanation of *crime* without a discussion of the influence of *place* (Bottoms and Wiles 1992).

URBAN GEOGRAPHY

Urban space is something to be passed through for the criminal, and this requires an expenditure of time and energy. Because this will also involve the transportation of illegal merchandise through public areas (Rengert 1992), it also involves a degree of risk. This frictional effect of distance (Rengert *et al.* 1999) has direct implications for such criminological theories such as rational choice theory (Clarke and Cornish 1985) and routine activities theory (Cohen and Felson 1979). In the absence of any other factors, an offender will most likely select targets that are close to home, making a rational choice to minimise the risk and effort required. They will be constrained to operate in areas in which they feel comfortable, areas where they may already pass during the routine activity of their day-to-day lives.

Offenders exhibit behaviour in space that can be modelled. The individual patterns and behaviour of an offender, can be aggregated with the behaviour of other criminals to develop patterns of offenders. Studies in Philadelphia have generated four main patterns of offender behaviour: a bull's eye centred on the home, bimodal centred on the home and a second anchor point, a teardrop shape between home and second anchor, and a bull's eye centred on an anchor point (Rengert 1996). These generalised models provide an excellent theoretical base. While confirming a linear distance decay from home or anchor point, they do not take account of the urban geography that generates social and environmental constraints.

An assumption made in many of the general models in the published literature is the idea that suitable targets are randomly distributed in space, and are equally accessible (see for example Brantingham and Brantingham 1981; Van Koppen and De Keijser 1997). More current research has corrected this view but the implications for criminological theory have not yet been realised, and the need for further research in the area of urban geography on target selection has been recognised by a number of authors recently (including Rengert *et al.* 1999; Rossmo 1995; Paul & Patricia Brantingham, 2000, *personal communication*).

In summary, the literature describes a model of offender behaviour with two central components. An empirically tested model of offender journey-to-crime and a theoretical construct that offenders are intimidated by different suburbs in which they feel out of place.

This project aims to add to this bank of knowledge with a study based in Canberra. The null hypothesis of this study is that boundaries between suburbs do not act to inhibit the movement of burglars and that there is no statistical indication that they prefer their own home suburb. The choice of Canberra as a study area is deliberate and is related to the need for a study region with clearly marked suburban boundaries. The choice of Canberra is based on the unusual metropolitan planning that has gone into the city and the resultant patterns. This history and the urban geography that has resulted is now discussed.

The urban geography of Canberra

The nation's capital is at the Northern end of the Australian Capital Territory (ACT). It is approximately 250 kilometres from Sydney, 480 kilometres from Melbourne and 150 kilometres from the coast. It is built on undulating land between 550-700 metres above sea level. Although it is a regional centre for south-eastern New South Wales the main employer in the city is the Federal Government, employing approximately 40% of the workforce in a city of about 330,000 people. The average disposable income of households in Canberra is the highest in the country and 34 percent above the national average. Over 90 percent of students complete Year 12 and the Territory compares well across Australia for health issues and life expectancy. Unemployment is always below the national average (SCRCSSP 2000).

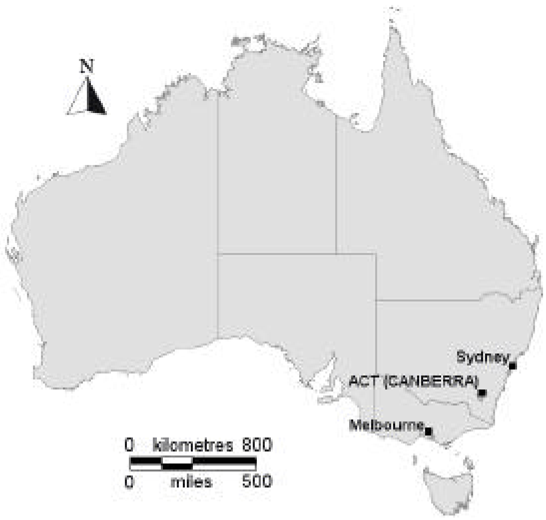

Figure 1 Canberra and the ACT.

Canberra (Figure 1) has an unusual urban geography. The city has not grown organically, slowly or rapidly expanding into the nearest available areas as needs dictated, but as a city designed and planned from the start. From the original drawings of the Architect Walter Burley Griffin through to the planned satellite towns of Gungahlin and Tuggeranong, all within a hierarchical transport system, Canberra has had a long and continuous history of metropolitan planning. In fact the site was acquired by the Government before development commenced. Land is subdivided and sites are not sold but leased for planned use. The relevance of this significant level of urban design to the current study are two-fold. Firstly the development of residential accommodation, and especially public housing in the capital, has been strongly influenced by the planned growth of the city and the timings of the release of new suburbs for development. Secondly the urban plan for Canberra has dictated the layout and design of the road system to support a hierarchical suburb and 'new town' urban structure. This has resulted in a generally clear demarcation of the inter-suburb boundaries and a planned development of community services within each region. The following sections will summarise the development of Canberra and then proceed to explain the significance of this recent history to the current study and patterns of urban burglary.

URBAN DEVELOPMENT

With Federation in 1901 came the need for a new capital for Australia. The 1911 launch by the Federal Government of a world-wide competition to design the national capital of Australia was eventually won by Walter Burley Griffin, a Chicago architect and landscape designer. The Griffin Plan was primarily focussed on the design of the central part of the city surrounding the parliament and government buildings, encircled by a city of 75,000 inhabitants (NCDC 1984). This Plan incorporated into it a number of principles relating to patterns of land use around the ACT and these still receive general adherence. The 1957 establishment of the National Capital Development Commission (NCDC) on the recommendations of a Senate Select Committee was partly in recognition that Canberra would eventually exceed the inhabitant limits of the Griffin Plan. The NCDC published a 1970 revision of an earlier plan[5], called *Tomorrow's Canberra*. The new Y-plan (so named because the topology of the design was a linear plan shaped like a Y) had a number of key features (NCDC 1984 pp.31-35):

1. **The Central Area**: Limitations to the development of the Central area (Parkes, Barton, Civic and the Administrative areas),

[5] The earlier 'Outline Plan' published in 1965 had been the subject of a transport study (the Canberra Area Transportation Study) that showed that if Canberra grew beyond 250,000 people the transport network would break down and the city would become overwhelmed by congestion and traffic pressures. The limitations of the Outline Plan were evident and required revision. **NCDC** 1984 'Metropolitan Canberra', Canberra: National Capital Development Commission.

2. **The Regional Structure**: The ‘Y’ shape incorporating development of Belconnen, Gungahlin and Tuggeranong.

3. **Towns and Town Centres**: Each town (Woden, Belconnen, Gungahlin, Tuggeranong, and to some extent Inner Canberra) was to have 100,000 to 120,000 people in satellite suburbs and was to support a shopping centre, police station and other community services.

4. **The Transport System**: On the hierarchical system, there was to be an express system between town centres and Civic Centre, supported by feeder bus networks in the surrounding suburbs connecting with a town centre hub. The express bus system was to run along peripheral parkways that would generally run outside residential areas.

5. **Landscaped Open Space**: Use of open space to reinforce the natural patterns of hills, and ridges to be used to define rural and urban areas.

These key features are still part of the Canberra design characteristics today. The 1970 plan has influenced urban planning in the capital for the last 30 years enabling developments to proceed with some degree of prior planning. For example, the recent land releases in the North of the ACT on the NSW border around Gungahlin were in the planning system in the late 1960s. The development of suburbs in the ACT can be seen from Figure 2 that shows the year of first settlement for Statistical Local Areas in the ACT.

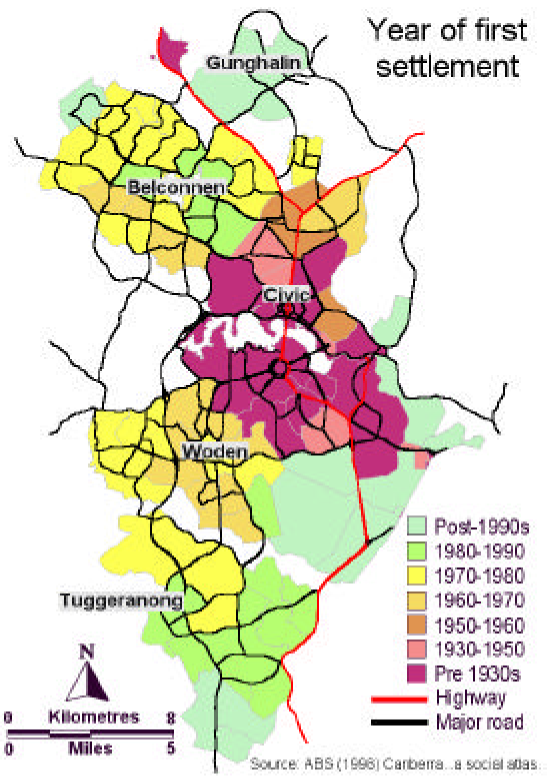

Figure 2 Year of first settlement for ACT suburbs.

Areas that were settled pre-1950 were to some extent covered by the Griffin

Plan and there has been a subsequent gradual release of land and development North of Civic and around Belconnen and Gungahlin, and towards Tuggeranong (ABS 1998 p.45). The current Canberran layout adheres closely to the original Y-plan. The principles of the Y-plan that are relevant to this study are:

1. **The policy of new town development**. This was deemed preferable to adding residential land and functionality onto existing developments that would require upgrading of existing services. This policy has therefore been one of rapid settlement of new towns rather than proceeding with a number of development areas. New suburbs are often targeted by new home buyers who are usually young couples or families. This creates a considerable degree of homogeneity in the demographics of a suburb for the years that follow (Walker 1981 pp.2-3).

2. **The maintenance of the residential hierarchical system**. Each town to have a centre acting as a focal point for the provision of community and retail services. Each town to be relatively self-sufficient and to be able to support the surrounding suburbs. Each suburb to have a central community area providing shops and other community structures as necessary.

3. **The maintenance of the road hierarchy system**. Linking each town are large parkways to carry large volumes of traffic reducing congestion on suburban roads. Major arterial roads are used as links between adjacent towns or other arterial roads. Sub-arterial roads are used to provide transport within towns and to penetrate into neighbourhoods. These higher order roads are noteworthy because they are characterised by limited, or no, frontal development and the setting back of residential properties from the road. Finally there are local access and distributor roads that act as simple access to residential areas and feeders to higher order roads.

4. **The location of industrial estates on the edge of urban areas**. This strict zoning of land use has concentrated industrial activity in a small number of areas.

The result of this pattern of urban development for Canberra has been highly structured suburbs with a hierarchy of road structure that serves to both assist the fluid movement of transport and also to act as a clear demarcation and physical barrier between suburbs. The borders of these arterial roads lack housing frontage and there are few spaces in fencing or gaps to provide access to suburbs other than at cycle paths or local access roads. The general pattern of development has been the creation of the road structure prior to housing development, therefore many suburbs are separated by dual carriageways that move traffic towards town centres and are fed by suburban feeder roads. A number of examples of dual carriageways that separate suburbs can be found in Appendix A. The suburbs themselves have developed over time around the gradual release of land in the ACT and this next section examines the development of housing in Canberra.

HOUSING IN THE ACT

Government provision of housing was central to the development of Canberra. A 1928 report by the Federal Capital Commission stated that "Owing to the lack of support by private enterprise, the Commission was compelled to assume the entire responsibility for providing residential accommodation, not only for the whole of the transferred public servant [mainly from Melbourne], but also for its own workmen and considerable staff." (ACT 2001 pp.11-12). Various attempts to encourage private ownership and private residential development staggered along but the government maintained the central role in the provision of housing in the capital for many years. Government management of the allocation of housing and the building of different types of property (rented out at different prices) began a process of socio-economic segregation across the city. This continued into the early post-war years. It was commented to the ACT Advisory Council in 1950 that "Houses in Forrest, when they become vacant, have not as a rule been allocated to people on low salaries. It seems the rule that officers with some standing retain the right to enter into residence in a better class suburb, while the rank and file have no recourse but to go into houses at O'Connor, Turner, Narrabundah and New Griffith" (ACT 2001 p.39). By 1955 there were 4,773 government houses in Canberra of which 67% were let to government employees. A further 1,891 dwellings were privately owned (28% of the total housing stock), but 700 of these had been built by the government. Housing allocation was reformed in the mid-1970s to bring the ACT more into line with other states. Although having voted 'no' in a referendum the government was preparing to impose self-government on the ACT. In 1989 the ACT became self-governing and the new ACT Government became the proud owner of a significant level of the total housing in Canberra – over 11 percent of all properties in the Territory were government owned. The spread of public housing was significant and up until the mid-1990s only three Canberra suburbs had no public housing.

Private purchase of government housing had varied over the years between areas. There was lower uptake of purchase options in less attractive suburbs and this meant that although the new (1989) ACT Government owned an 11-12 percent share of the whole housing stock, they owned a third of all properties in Ainslie, more than 25 percent of Narrabundah but less than 5 percent in many suburbs in the newer towns (ACT 2001 p.87).

The most recent figures from the 1996 census indicate that of the approximately 115,000 dwellings in Canberra less than eleven percent of residential properties in the city are government owned and rented to the tenants (Table 1). While this is approximately the same percentage of government owned housing that the ACT Government became responsible for on self-government in 1989, this is a considerable development from the early days of Canberra where nearly every property was built and owned by the government.

Table 1 Housing ownership and occupancy in Canberra.

Housing type	Percentage of all occupied private dwellings
Owned outright by the occupant(s)	30.5
Being purchased by the occupant(s)	34.9
Rented - government owned	10.7
Rented - privately owned	21.7
Other	2.2

Source: ABS (1998).

Figure 4 shows the levels of government housing stock across Canberra at the 1996 census, the most recently available 'snapshot'. Not only have levels of public housing changed, but also the occupancy and type of housing had also dramatically changed. Housing shortages in the late 1950s and early 1960s had driven the need for estates of flats instead of houses, and properties that were once occupied by government-employed tenants are now the home to individuals and families who are generally on government income support. The vast majority (95%) are assessed as being in need of financial housing assistance.

Summary

What emerges from this examination of the urban design and intensively planned nature of Canberra is a picture of a city with a number of key characteristics for this study:

- Major dual carriageways with median strips and no building frontage separating many suburbs (see Figure 3).
- Other suburbs separated by single carriageways but again, no house frontage.
- Each suburb having its own shops and being self-sufficient for daily needs.
- Many suburbs having their own community infrastructure such as schools and churches.
- Neighbouring suburbs being developed within a few years of each other as satellite suburbs to new towns.
- Original neighbourhood dwellers displayed considerable homogeneity in terms of socio-economic status and age, but these patterns of suburban occupation have increased in variety significantly as time has passed.

Figure 3 Hindmarsh Drive, between the suburbs of Waramanga and Weston.

- Original patterns of extensive government ownership of rental property have changed in recent years and public ownership of residential property is now less significant in the housing structure of Canberra, and more varied.

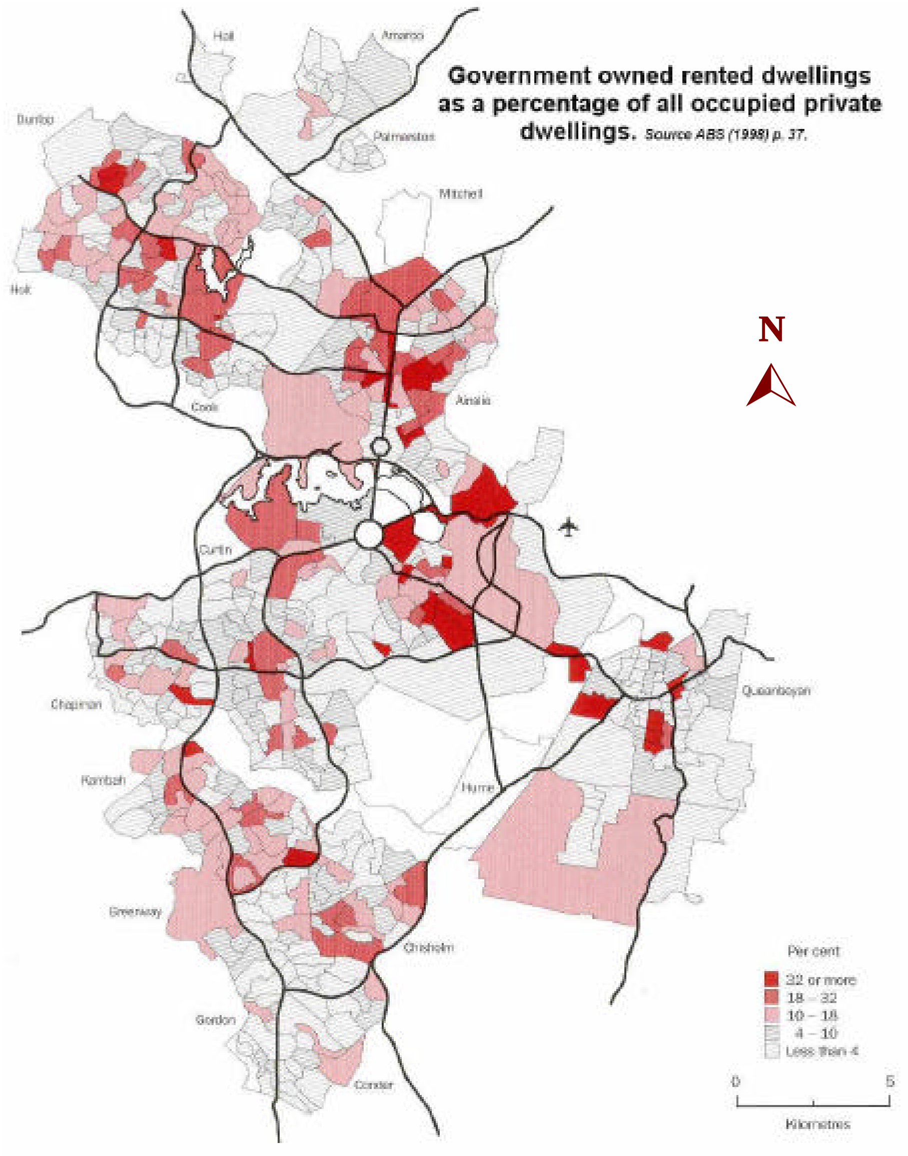

Figure 4 Levels of public rental properties across Canberra.

Methodology

Spatial analysis of crime events and offender distributions is a rapidly growing area of applied research. The creation by the US National Institute of Justice of a Crime Mapping Research Center has helped fuel interest in mapping techniques in the law enforcement community (Ratcliffe, 2000). This research project has developed an innovative technique to re-engineer a geocoding database for a Geographical Information System (GIS) to generate a database of targets. The 'potential targets' database is used to directly examine the issue of target suitability within distances from the offender's anchor point, and this technique is described in greater detail in the following sections. This is followed by the application of the technique in the central analysis of this project, but first there is a description of the data sets employed in this research project.

Data used in the study

GEOGRAPHICAL DATASETS

Boundary files for suburbs in Canberra were obtained from CData96, a product of the Australian Bureau of Statistics. This product contains boundary files for Statistical Local Areas (SLA) and in Canberra these are synonymous with suburban areas. CData96 retains these boundaries in digital format compatible with MapInfo, a proprietary GIS. This was the main analytical tool in the project.

Street files were employed to geocode the crime locations, the residence's of offenders, and other addresses in Canberra as necessary (the reason for this last requirement is described later in this section). The street files used were purchased from MapInfo and comprised of versions 5 and 6 of StreetWorks Australia for the ACT.

Each street consists of a digital line with a start and end node. Each street line contains attribute data that defines the street name, and the house numbers on both sides of the street for that segment of line (Figure 5).

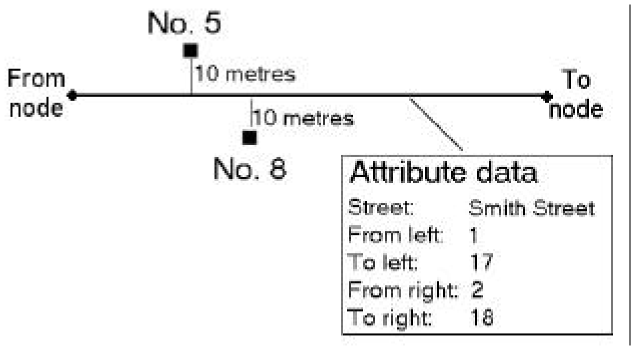

Figure 5 Example street line segment.

Source: Ratcliffe, J. H. (2001). "On the accuracy of TIGER-type geocoded address data in relation to cadastral and census areal units." International Journal of Geographical Information Science 15(5): 473-485.

CRIME DATASETS

Data was made available by the Australian Federal Police (ACT Policing) for this study. This consisted of locations and brief offence (such as dates and times) details for all burglaries in the ACT for 1999 and 2000. There are just over 15,000 offences recorded in the dataset. It is perhaps worth noting that the AFP PROMIS database is not designed for the extraction of large volumes of data for analysis and the initial data quality was poor. The files were full of duplicate or incomplete records. A significant amount of time was spent by the author, often with the assistance of an AFP intelligence analyst, cleaning the data prior to analysis.

The APF also provided details of all individuals arrested for burglary in the ACT for 1999 and 2000, in line with the agreement for this project. This file consisted of the home address of the suspected offender and brief biographical details such as sex and age. Once the dataset had been stripped of duplicate or incomplete records, there were 400 suspected offenders that were matched to offence locations.

These two datasets were used by the author as the basis for a secondary analysis of burglary patterns in Canberra on behalf of the Australian Institute of Criminology (AIC). A publication entitled "Policing Urban Burglary" was prepared as a paper in the AIC series Trends and Issues in Crime and Criminal Justice (Ratcliffe in press). A summary of the findings of a general spatial and temporal analysis of the data is taken from this paper and provided here, as an introduction to the data set and as a summary of the burglary situation in the nation's capital.

SUMMARY OF BURGLARY IN CANBERRA

Over the 2 year period (1999 & 2000) 70.3% of burglaries were classified by the ACT Police as occurring at dwellings (residential), 9.6% at shops and 20.1% at premises classified as 'other'. This last category includes churches, sports clubs, schools and other educational establishments. 30% of burglaries therefore occurred at non-residential locations.

The highest probability for residential burglaries is during working hours between 8am and about 6pm, a period characterised by most of Canberra being away from home at work. Residential burglary levels are lower over the weekend. The temporal pattern for non-residential burglary is almost exactly reversed. Non-residential burglaries increase over the weekend and overnight when many commercial premises, schools and colleges are unattended. Given the work patterns of most individuals and the operating hours for the majority of businesses in Australia it would appear reasonable to conclude that these patterns are mimicked in other urban environments. With this clear demarcation of burglary type by temporal pattern it is clear that the spatial and temporal patterns of residential and non-residential burglary should be examined separately, as is done in this study that focuses on residential burglary.

There are just over 120 suburbs in Canberra. Fewer than a quarter (25) of the ACT suburbs were the victim of half the residential burglaries. Hotspots include the more established suburbs of the inner North of the City (Suburbs of Ainslie, Lyneham, O'Connor, Braddon, Campbell, Reid, Dickson, Downer and Turner) and the inner South-East (Suburbs of Narrabundah, Griffith, Forrest, Symonston and Red Hill). There was a far greater spread of residential burglary activity across Canberra than with the non-residential burglary and the most targeted regions included both old and more recently developed suburbs of the ACT. Housing type, density and types of occupancy (public and private housing) of the residential burglary hotspots vary considerably across the city.

11 suburbs accounted for over half of the non-residential burglaries in the ACT and the four commercial centres (The commercial centres of Fyshwick, City, Belconnen and Phillip-Woden) were highly targeted. Architect Walter Griffin's original 1913 plan for the

layout of Canberra allocated suburbs as commercial, public sector and residential areas of the city. This demarcation of residential and commercial land use is evident in the distribution of burglary.

This concentration of business premises is an unusual feature of Canberra and the concentration of non-residential burglary is a feature that may not be replicated in other cities. In some respects it is advantageous in that it provides opportunities for concentrated crime prevention activity but it also provides an Aladdin's Cave for the offender.

The mean age of an offender is 19.5 years (median 16 years) for residential burglaries and slightly higher at 20 years for non-residential burglary (median 18 years). The mean residential burglary offender figure is however skewed by a small number of older offenders. A quarter of detected residential burglaries are committed by offenders under 16 years old, and half are committed by offenders under the age of 18. Eighty-two percent of detected burglaries are committed by males. Seventy percent of burglaries are committed by lone offenders with a further one in five being committed by two offenders working together. A small minority are committed by offenders working in larger groups, though some caution should be applied in interpreting these figures. The recording of numbers of offenders relies on either capture of offenders at the time of offence or individuals admitting to police the involvement of others. These figures are therefore likely to have an element of unreliability.

The average journey from the offender's home to the burglary target is 5 kilometres (3.1 miles) for residential burglaries and 4.9 kilometres (3 miles) for non-residential burglary offenders. This figure agrees with broad findings from the UK and the US (reported in Wiles and Costello 2000 and Rossmo 1995) and is slightly longer than those reported by Barker (2000). Again however this figure is skewed by a small number of offenders who travel relatively long distances. A third of burglaries are committed by offenders who have travelled less than about 1,500 metres (one mile) from their home address. Surprisingly, considering the unique geography of the ACT and the segregation of industrial and residential regions, this figure is the same for non-residential burglaries. This is accounted for by a substantial number of non-dwelling burglaries within residential suburbs at shops, schools and community buildings. Less than half of the burglaries are committed by individuals who have travelled more than 3 kilometres (just under 2 miles). This finding corroborates the research mentioned earlier and has a theoretical basis in the distance decay model of environmental criminology (Rengert *et al.* 1999).

DATA SECURITY

A small note on data security. All data containing confidential personal information was and is stored using a hard drive encryption program employing a 448-bit Blowfish 2 encryption algorithm.

A SUMMARY OF THE DATA

Data relating to burglaries in Canberra were made available from the ACT Police, as previously stated, for the period 1999 and 2000. There was also a small additional amount of data relating to the first 10 weeks of 2001. After considerable data cleaning and matching of records a final data set of geocodable offence locations and geocodable offender home addresses was established. This data consisted of 534 offence and offender matched locations. Of these, 33.2% related to non-residential burglaries and were excluded from the final analysis. This left a total of 357 records that were retained to the next stage of the research project.

Analytical technique

A criticism of previous geographical analysis of burglar journey-to-crime is that density of housing, and therefore target opportunity, are often assumed to be approximately uniform. This assumption that if one burglar travels 1000 metres to commit a burglary then he must have ignored more opportunities closer to home than a burglar that travels only 700 metres appears to drive a lack of complexity in many analyses. On this assumption researchers are able to generalise about the travel patterns of offenders and assume that they have not taken opportunities that presented themselves close to their home base. A further point to consider is that the uniformity of housing is also assumed to exist in a concentric pattern around the offender's domicile. Studies have used expanding search bands of similar mathematical area to examine distance patterns of offenders (Rengert, et al. 1999) but again, while useful as a theoretical construction for discussing the mathematical processes, does not get to the root of geographical urban reality. Offenders have this annoying habit of living near schools or playing fields or areas of wilderness. Where one criminal might have 350 houses within a 500 metre radius of his home, another will only have 80 houses within the same distance, and in one direction. Although both offenders may travel 500 metres to commit a burglary, one has been exposed to a far greater range of opportunities than the other.

In an attempt to overcome these methodological difficulties this project focuses on actual addresses and the behaviour of residential burglars in Canberra. As the offenders reside in, and target, residential addresses it is necessary to generate a map of actual home addresses to determine an accurate map of potential target availability in the criminal range of each offender. In this manner it is not necessary to make the possibly erroneous assumption that if distance increases from the home address then opportunity must increase proportionately. This project developed the following method for Potential Target Generation (PTG) using programming software (MapBasic) for the MapInfo GIS package.

POTENTIAL TARGET GENERATION PROCESS

This section describes the methodology of the Potential Target Generation (PTG) program. For each offence there is an offence location, expressed with X and Y co-ordinates. There is also at least one offender home location, similarly co-ordinated. It is therefore possible to generate pairs of points to use for each analysis (offender home and offence location). These points were used to develop a map of potential targets in the following manner:

1. The home address of an offender and the location that they burgled are geocoded and plotted on a map, with a line from the home address to the target property (Figure 6a).

2. The home x and y and target x and y co-ordinates become the centre and radial point of a circle around an offender's address. All of the streets within the circle are captured. To ensure capture of all streets within range of the offenders home the circle size is expanded by increasing the radius by 10% (Figure 6b).

3. The captured street segments are interrogated to generate a list of street names and to ascertain the highest street number in all of the streets (Figure 6c).

4. The PTG program attempts to geocode a point for every street number from 1 to the highest recorded, for every street name within the expanded circle. Only addresses that actually exist are generated, though many may exist outside the original circle generated by the offender home and target points (Figure 6d).

5. Only those addresses that exist within the actual circle (smaller than the original expanded circle) are selected and become the subject of the analysis (Figure 6e).

6. Residential properties within the (red) circle are sorted by suburb and the percentage of properties within the circle that are in the offender's residential suburb are calculated.

7. This process is repeated for each record in the study.

(A) Home address of offender becomes the start point of a line from the offender's home to the target burgled property.

(B) The program then generates a circle using the line as the radius of a circle to capture all of the streets in range. The circle is expanded by 10% to ensure a complete capture.

(C) Using the captured streets, the program generates a list of all possible addresses and sends this list to the geocoding engine of the GIS, creating points at all possible addresses.

The Potential Target Generation (PTG) process as applied to all marauder offences in the ACT residential burglary data set.

(D) A new circle is drawn using the two addresses (offender and target) as the radius of the circle. This is not an expanded circle.

(E) Finally, all addresses within the Eucludian distance of the offender home/target distance are selected. These become the subject of analysis.

Figure 6 PTG program process.

The PTG program is able to generate for each offence location and burglar home address a map of residential addresses that were within the same or less Euclidean distance from the offender's house as the actual target selected. This gives the analysis the ability to see the real number of houses that were theoretically closer or at least the same distance from the offender's home that were available to the offender but not selected. This number of potential targets is based not on a belief in uniform target availability and housing density but on real geography.

There are two *caveats* that should be mentioned at this point. Firstly, this work does make the assumption that there is a reasonable level of accuracy in the StreetWorks data set from MapInfo and that addresses available for geocoding in the dataset do actually exist. Secondly, it does make the generalisation that Cartesian distances are correlated to effort distances. That is, if two addresses are the same distance from the home location then the effort to travel from the home site to both locations will be about the same. This is a generalisation of course, but because distances within the marauder data set (to which this analysis is applied) are so small and the availability of intrasuburb routes so high throughout Canberra, this is not felt to be a significant flaw in the analysis.

The strengths of the PTG approach are that no assumptions need to be made about housing density or uniformity of residential areas, the existence of non-residential land use in residential suburbs does not need to be ignored, and the complexities and subtleties of residential patterns can be replicated with a high degree of accuracy. The approach does not however consider the effort required to cover distances and therefore Cartesian distances are assumed to equate to effort distances.

Application

COMMUTERS OR MARAUDERS?

As mentioned in the 'Summary of the data' on page 23, 357 residential burglary records were considered for the analytical phase using the PTG program. From a theoretical perspective it is questionable to include commuter offenders (described on page 10) in this analysis. If the criminal range of some offenders shares little overlap with their home range (Canter and Larkin 1993) then a purely quantitative analysis (such as this research) will do little to determine the qualitative factors that drew them well away from their home range. The remainder of this analysis therefore focuses on the marauder hypothesis type offenders.

Canter and Larkin (1993) examined multiple serial rapists to determine if an offender was of a marauder or commuter type (described on page 10). This relies on multiple offence locations for an offender based at one site. This is not possible in this study and there are too few offenders with multiple offence records in Canberra. Although burglary is a high volume crime, detection rates in the ACT are not especially high and there is a paucity of data in this area. This study has therefore employed a more pragmatic definition of marauding offence.

Definition of a marauder offence for this study: An offender home-offence location record was classified as marauder or commuter on the number of suburb boundaries crossed to commit the offence. A marauder record for this study is where an offender has either stayed in his or her home suburb, or has targeted a neighbouring suburb which shares a common boundary with the home suburb. By applying this filter 210 commuter records were extracted leaving 147 marauder records for analysis.

The 147 marauder records were analysed with the PTG program and, once every possible target address was mapped, the percentage of potential target addresses within the offender's home suburb was calculated using an aggregate function within the GIS. This was combined with a simple binary value to determine if the offence location was in the same suburb as the offender's home.

Results of these tests are described in the next section.

Results

This section describes the results of the analyses conducted on the various study areas, covering specifically;

1. The results of tests of the assumptions made about urban geography,
2. The distribution of offender/offence locations in relation to the distribution of suburbs.

This section begins by discussing the value of applying the PTG program in the analysis of the offender home/target distance relationship. After all, why go to the lengths of the software process described in the previous section if the availability of targets is a direct function of distance or other standard geographical variables?

Target availability and distance

Figure 6 described the PTG process using one example from the Canberra Marauder residential burglar data set. The example used shows the distribution of housing (blue dots represent individual houses) around the offender's residence (at the centre of the image) as fairly uniform with an even density of housing expanding in every direction (Figure 7a). On this basis it would be reasonable to

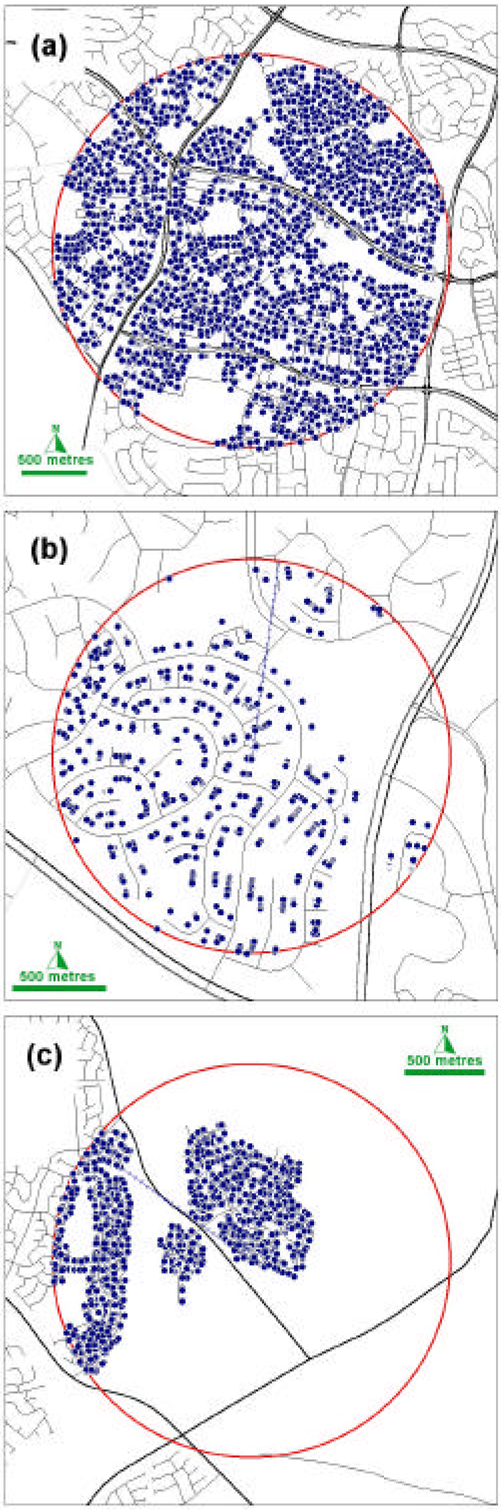

Figure 7 Variations in urban residential housing.

assume a distance/housing density correlation, however as can be seen in the second two parts of Figure 7, real housing areas demonstrate a marked variety. Firstly the density of housing changes from older and lower socio-economic areas to newer suburbs and areas where more affluent people live, areas that usually have larger housing blocks. Although there is a difference in scale between Figure 7a and Figure 7b, this is not enough to account for the smaller number of houses in 7b, and the larger block sizes are evident.

The second reality of modern urban geography is that there are often areas of the urban mosaic that are either used for non-residential purposes (schools, factories, etc.) or are undeveloped (waste ground, farmland or parkland). This can be seen in Figure 7c and in the North-Eastern part of Figure 7b.

CORRELATION AND REGRESSION DATA SET

The 147 marauder residential burglary data set was used as a real data set to test three different methods of assessing criminal opportunity (defined as residential properties). However in the case of 42 records, the offender suburb and the offence suburb were the same, and this would significantly skew the tests. These records were therefore removed, leaving 105 records for analysis. The study used two fixed points as the radius of a circle, with the offender's home at the centre, and the burgled property at the edge of the circle. Within this circle it was possible to generate a mapped point (using the PTG program) for every possible residential property, and to calculate which properties were in different suburbs. For each "offender home-target" pair it was possible to calculate:

1. The distance.
2. The number of properties (addresses) that were generated by the PTG process (including the offender's home and the target property).
3. The percentage of the houses that were in the offender's home suburb.
4. The percentage of the landmass of the circle that was in the offender's home suburb.

This information was compared using correlation analysis to ascertain the level of correlation between the data variable. The results of the Pearson (parametric) analysis are below. All relationships are significant at the 0.01 level for a two-tailed Pearson Product-

Moment test. The Pearson correlation coefficients shown in Table 2 are a measure of the linear association between the two variables in the matrix. The range of possible values is from -1 to 1. The sign of the coefficient indicates the direction of the relationship, and its absolute value indicates the strength, with larger absolute values indicating stronger relationships. This means that the closer the value is to 1.0 or –1.0, the stronger the relationship.

Table 2 Correlation matrix for four urban geography variables.

	Distance [1]	Addresses generated [2]	% addresses in home suburb [3]	% landmass in home suburb [4]
Distance [1]	1.000	.896	-.701	-.786
Addresses generated [2]	.896	1.000	-.714	-.730
% addresses in home suburb [3]	-.701	-.714	1.000	.945
% landmass in home suburb [4]	-.786	-.730	.945	1.000

All of the variables are strongly correlated (positively or negatively) as we would expect. Most geographers would consider that there would be a correlation between increasing distance and the number of addresses within that distance, that you would also see a decrease in the percentage of land that is within the same suburb as distance increased, and that the percentage of addresses within the distance would also decrease as distance increased. These assumptions are borne out in the strong correlations between all four variables in this test. There is a clear correlation between all four variables.

Yet the common assumption made by criminologists studying the geography of local crime and journey to crime studies is that the relationship between distance and target availability is a **linear** one. A linear regression analysis of the sub data set mentioned on page 30 was conducted, comparing the independent variable 'distance' [1] with each of the other variables, to assess the suitability of distance alone to predict changes in the other variables in a linear fashion. The regression variables are shown in the next table. The values used to derive the results are available in Appendix B.

Table 3 Linear regression predicting three variables with an independent variable 'distance'.

Dependent variable	Intercept	Independent coefficient	Adjusted R square
Addresses generated [2]	-1222.518	4610.481	0.802
% addresses in home suburb [3]	93.688	-27.820	0.485
% landmass in home suburb [4]	89.825	-30.475	0.615

While the correlation analysis in Table 2 showed that the variables are correlated, this analysis allows us to see the nature of any linear relationship. The key value here is the Adjusted R-square. The R-square value is able to measure the proportion of the **variation** in the dependent variables [2,3 and 4] that was explained by variations in the independent variable [distance – 1], while the more commonly used adjusted R-square is a measure of the proportion of the **variance** in the dependent variables that was explained by variations in the distance. The differences are negligible here, because there is only one independent variable. The Adjusted R-square is sensitive to irrelevant variables which is not a factor when only one independent variable is used.

While all of the regressions are statistically significant, it is clear that distance alone is not sufficient to reflect the complexity of the urban geography. If you wished to predict the percentage of addresses within a certain distance of a point that were in the same suburb as the point (using distance[1] to predict % addresses in home suburb [3]) then the use of distance alone would only reflect 48.5% of the variation in the actual layout of Canberra. Similarly if you wished to predict the landmass (actual area of land) that was in the same suburb as the point, as distance increased, the regression would only allow you to reflect 61.5% of the actual variation. These two results show that distance is not an ideal method of predicting the extent of a suburb from a central location as distance increases.

Most importantly for this study, the first line of Table 3 shows that nearly 20% of the variation in the actual number of addresses generated within a given distance of a point is lost when distance alone is used to predict the number of residential homes in that area. This is a significant level of variance that is important to this study. This analysis, which has not to the author's knowledge been conducted before in this type of urban geographical study, shows that there is sufficient variation in both the pattern and density of the urban geography around residential areas to reappraise journey to crime studies that have relied on increasing distance as a linear model of increasing opportunity. While this is generally the case, the loss of 20% of the variation in the housing population is a significant number.

Given this important result, the rest of the analysis that follows uses the PTG process to analyse the burglary data for Canberra, and utilises the percentage of addresses in suburbs with addresses generated through the PTG process.

Target selection and suburbs

This component of the study made use of 147 burglaries where there was (1) a match in the database from a residential burglary and a detected offender with a known residence at the time of the offence, and (2) where the offender had either burgled their own or a neighbouring suburb.

Of these 147 offence/offender records, 50 were records where the circle based on the offender home and the offence location radius was contained within one suburb. That is, given the distance travelled by the offender is known, had the offender travelled in **any** direction from his home address, then he would still have been in his home suburb. These records were therefore excluded from this section of the analysis, leaving 97 records.

Within these 97 offence/offender records, the average age of the offender was 18.8 years (range 12 to 54 years), and the average distance travelled to commit a burglary in the home or neighbouring suburb was 1.3 kilometres (range 0.3 – 3.6 kilometres).

For each offender/offence record it was possible to answer a number of questions:

- Given the distance travelled by the offender, if that offender had travelled in any direction, how many potential target addresses were within range?
- What percentage of these potential addresses were in neighbouring (i.e. not the home) suburbs?
- Did the offender target the home or a neighbouring suburb?

By aggregating the results of each offender together, in a process termed aggregate criminal spatial behaviour (Brantingham and Brantingham 1984) we can examine if the pattern of behaviour of offenders in Canberra differs from a theoretical distribution. The answers to the above questions are aggregated into the following table.

Table 4 Inter and intra-suburb burglary distribution.

% of potential addresses within the HOME suburb	HOME suburb targeted	NEIGHBOURING suburb targeted	Total offences
100-90	10	5	***15***
90-80	3	3	***6***
80-70	6	5	***11***
70-60	5	6	***11***
60-50	6	6	***12***
50-40	1	8	***9***
40-30	2	11	***13***
30-20	1	12	***13***
20-10	0	7	***7***
0-10	0	0	***0***
Total	***34***	***63***	***97***

This information can be displayed in graph form as follows:

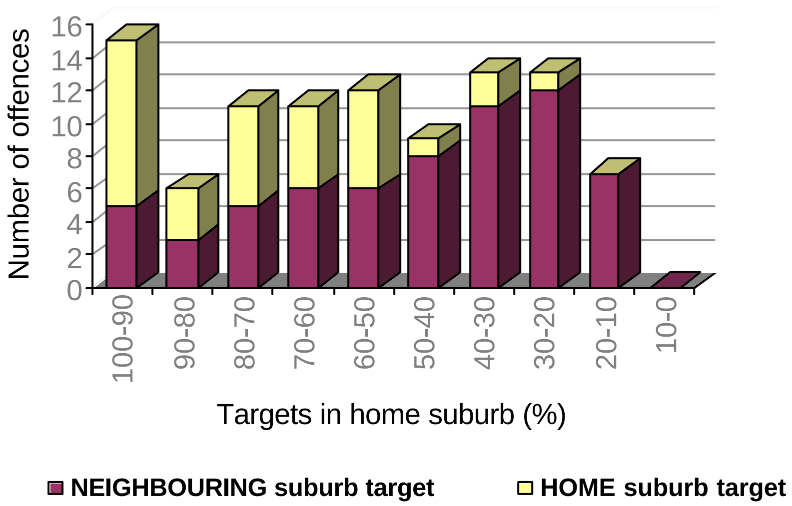

Figure 8 Inter and intra-suburb burglary distribution.

Although this shows absolute value, it is difficult to see any relationships due to the emphasis on actual values as opposed to the distribution within each decile. If the same information is viewed as a percentage distribution within each band, the range of values can be more clearly seen. The last category of 10-0 percent has been removed as this class had zero values in both variables.

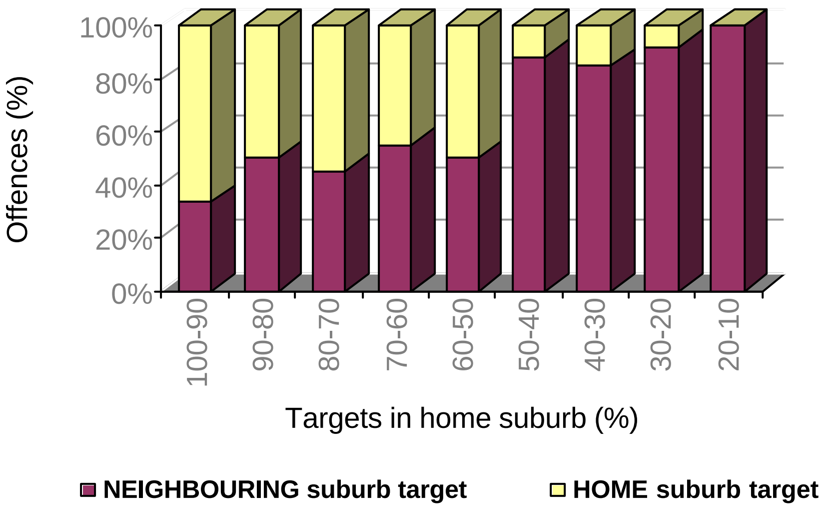

Figure 9 Inter and intra-suburb burglary distribution as a percentage in each class.

Figure 9 allows us to see that as the percentage of potential targets that are within the home suburb drop, there is an increase in the number of targets selected from outside the home suburb (dark red). This is as we might expect if the impact of the more significant urban barriers of dual carriageways and grassed and vegetated areas is not significant in hindering offender movement. The question to answer here is, is this significantly different from a expected theoretical distribution?

An expected theoretical distribution can be derived from a relatively simple calculation. Given that Table 4 tells us that 15 offences (crimes in the home suburb C_h) happened within circles where the offender was within 90 to 100 per cent of home suburb targets, we can use the mid point of this 90 to 100% band (95% or 0.95), and estimate that the expected number of offences that would be within the home suburb is C_h x 0.95, or in this case 15 * 0.95 = 14.25.

This can be repeated for the complete range, and the expected theoretical distribution would look like Figure 10, remembering that the 10-0% class has been removed, lending the display a slightly uneven appearance.

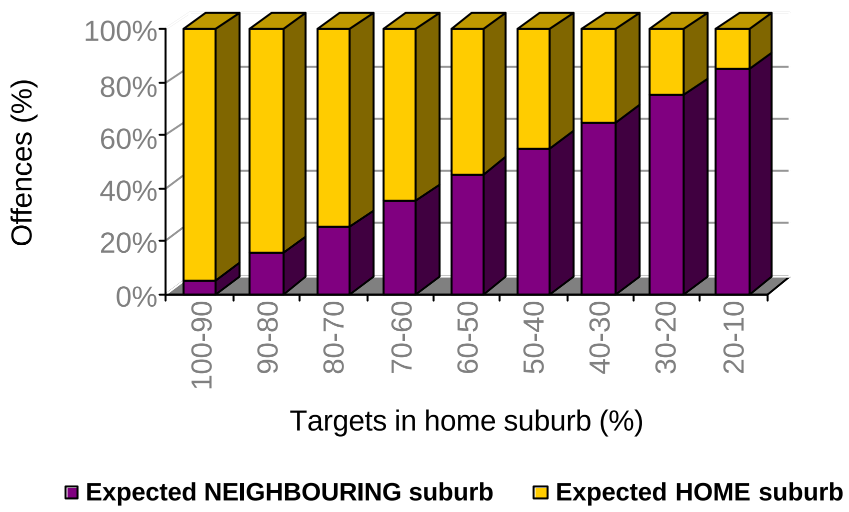

Figure 10 Theoretical expected suburban crime distribution.

There is one final consideration that must be included before the expected and observed distributions are compared; the fact that some offenders were working with accomplices.

CORRECTING FOR ACCOMPLICE CRIMES

In an ideal world, and especially for this study, offenders would work alone to commit burglaries. It would make the life of the crime researcher, and the crime analyst, so much easier. Unfortunately it is a reality that some offenders work in tandem with one (or more) partners in crime and this has an impact on this study.

Given that the aim of this study is to enquire if boundaries between the territory of urban suburbs act to inhibit offender movements, there is a problem with the model if they are acting with residents of a neighbouring suburb. If that were the case, then the inhibiting factor (if any) of the territorial boundary of the suburb does not work if they are with a resident of that suburb or a frequent visitor by association.

The impact of this on this study means that the graph at Figure 9 has to be corrected for those neighbouring offences where the offender was arrested with a resident of that suburb. The result of this correction for accomplice crime is shown in Figure 11.

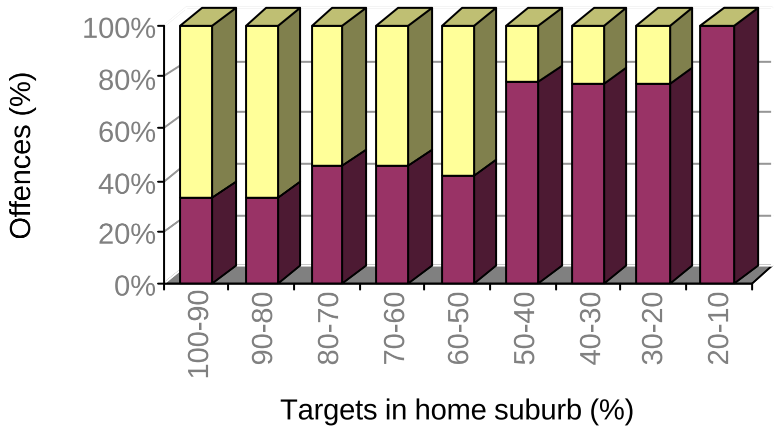

Figure 11 Inter and intra-suburb burglary distribution as a percentage in each class, corrected for accomplice crimes.

The corrected distribution was compared to the expected theoretical distribution using a standard Chi Square test. Values for the test are given here (Table 5).

Table 5 Chi Square test values.

% of potential addresses within the HOME suburb	Observed distribution (corrected)	Expected theoretical distribution
100-90	10/15	14.25
90-80	4/6	5.1
80-70	6/11	8.25
70-60	6/11	7.15
60-50	7/12	6.6
50-40	2/9	4.05
40-30	3/13	4.55
30-20	3/13	3.25
20-10	1/7	1.05

TEST RESULTS

The Chi Square test compares expected distributions of the percentage of addresses in the offenders' suburbs against the observed percentage of times that an offender burgled in their home suburb in each 10 per cent range. With a test statistic of 0.82372216 and 8 degrees of freedom, the differences between the observed values and the theoretical expected distribution are **not statistically significant**. The implications of this result are discussed in the next section.

Summary

Urban geography

The geographical analysis beginning on page 30 raises a number of issues regarding the spatial analysis of crime. To realistically understand the geography of criminal opportunity around offenders' homes it appears from this analysis that we must also appreciate the realistic geography of the opportunity. In the analysis that forms the basis of this study, the important factor is the availability of targets in and out of the offenders' home suburb.

It is possible to either estimate this target availability through an assumption of linear degradation of local suburban availability, or to actually generate cartographically all of the target addresses. This study does the latter, and the value of this is evident from Table 3. The percentage of addresses in the home suburb were calculated from the PTG process. The use of a linear distance interpolation was found to reflect less than half of the variation in the actual geographic distribution of the suburbs in Canberra.

Even the closest correlation with distance, found with the number of addresses generated, failed to address about 20 per cent of the variation. This is a significant finding for a research area of 'journey to crime' that has endeavoured to find a relationship between criminal activity and distance from the home address. While a relationship clearly exists, that relationship is now slightly more complicated by the urban geography. Criminal activity is both a function of distance and perceived distance, but a higher density of addresses, or a complicated distribution of properties in the area, means that the functions of distance are complicated by variations in patterns of housing and property density.

This study has examined the impact of urban barriers on offender travel patterns. In this study the definition of an urban barrier is a variable thing, defined as the boundary between fixed suburbs in Canberra. The study did not find any significant difference between the theoretical distribution of offender opportunity/behaviour and the observed results from the study. The impact of the boundaries between suburbs is not therefore significant. For the non-Canberran resident it might be useful to see the types of boundaries common in Canberra.

The sets of paired images (map and photograph) in Appendix A show sections of road that lie directly on the boundary between suburbs that were crossed by offenders. On the maps, the blue arrowed line originates from the home address of the offender and extends to the targeted address. This is a straight line graphic that does not intend to imply that this was the route of the offender. On the maps, the red pentagon and two red lines indicate the approximate camera position, direction and limits of view.

Environmental criminology theory

Most of the existing research that has examined the issue of territoriality has looked at the most local level, in and around the home address and immediate block area (Brown and Altman 1981; Taylor 1988). At this level the theoretical construction of 'Defensible space' is applicable (Newman 1972) though most of the research has been at the individual property level (Ham-Rowbottom, et al. 1999) or at most the level of a housing estate (Coleman 1985). It should also be noted that the theory of Defensible Space is not without its detractors (Bottoms 1974; Hillier 1988). Taylor (1988) summarises by suggesting that the more a territorial analysis is localised around a property (i.e. at the microlevel), the more applicable are the concepts of human territorial functioning.

The research presented here would certainly concur with the views of Taylor in that there is no statistical difference in the choice of suburb target selection of offenders in the study and an expected theoretical distribution. There is no evidence that the extra barriers between many suburbs created through additional vegetation, more carriageways and fewer suburban entry points acts to inhibit the travel patterns of offenders.

In the understanding of travel patterns of offenders, this study would appear to suggest that physical boundaries are not a factor in inhibiting the travel patterns of offenders. A substantial number of offenders are most likely travelling on foot, given that a third of arrested offenders are under the age of 16 years. If any inhibiting factor exists to offender travel behaviour, it may only exist from the socio-economic variation between areas. It has not been possible to test the impact of socio-economic differences, as the differences between suburbs in Canberra, from a socio-economic perspective, are miniscule compared to other areas. This might be the sort of work that could be completed in one of the larger North American metropolitan areas where income levels and housing conditions change rapidly between many neighbouring areas.

The findings presented here would suggest that expenditure to fortify the exterior of a suburb or neighbourhood against external offenders would largely be wasted money. There is no evidence from this study that offenders are inhibited in their travel patterns between suburbs in Canberra. Increased physical barriers alone are unsuccessful, unless they were to enclose the whole suburb and actually block access. Territoriality of suburban residents would not appear to extend as far as the neighbourhood boundary.

This project aimed to further our understanding of the impact of urban geography on the target selection patterns of offenders. Within the limitations of a purely quantitative study, it has been possible to rule out physical barriers such as extensive road networks and vegetation strips as mechanisms for protecting suburbs from infiltration by outside offenders.

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Appendices

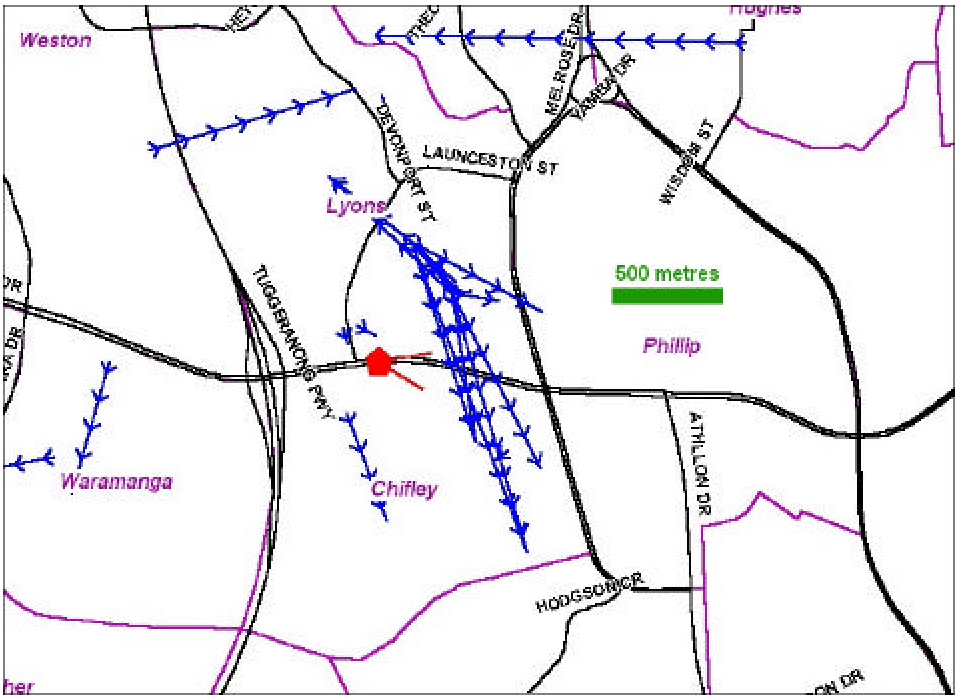
Appendix A: Urban barriers in Canberra

Appendix B: Distance, address, and urban geography regression data

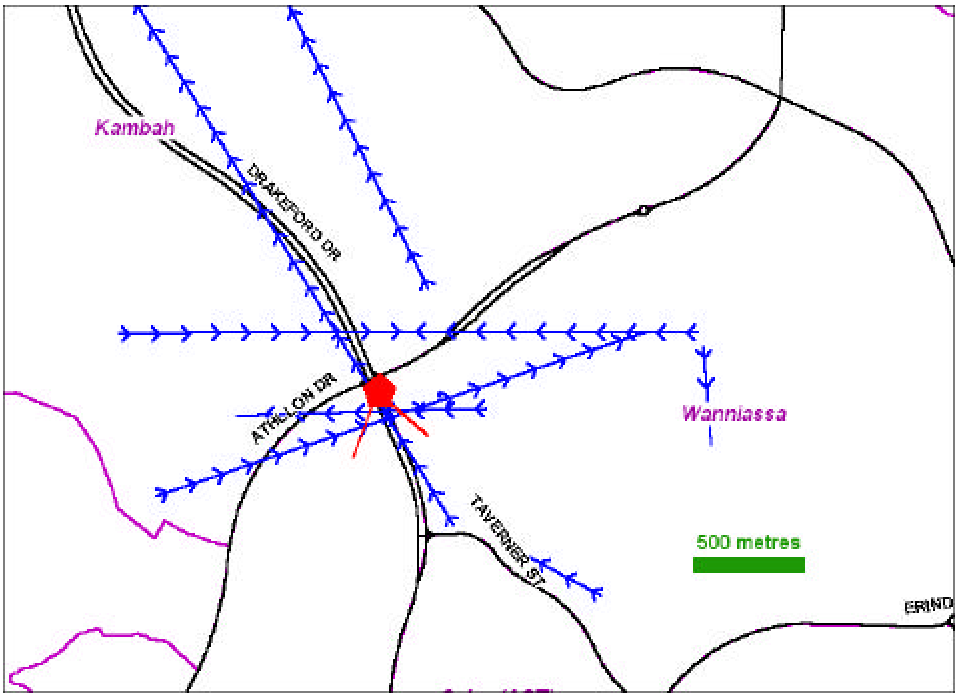
Appendix A: Urban barriers in Canberra

On the maps, the blue arrowed line originates from the home address of the offender and extends to the targeted address. This is a straight line graphic that does not intend to imply that this was the route of the offender. On the maps, the red pentagon and two red lines indicate the approximate camera position and direction of view.

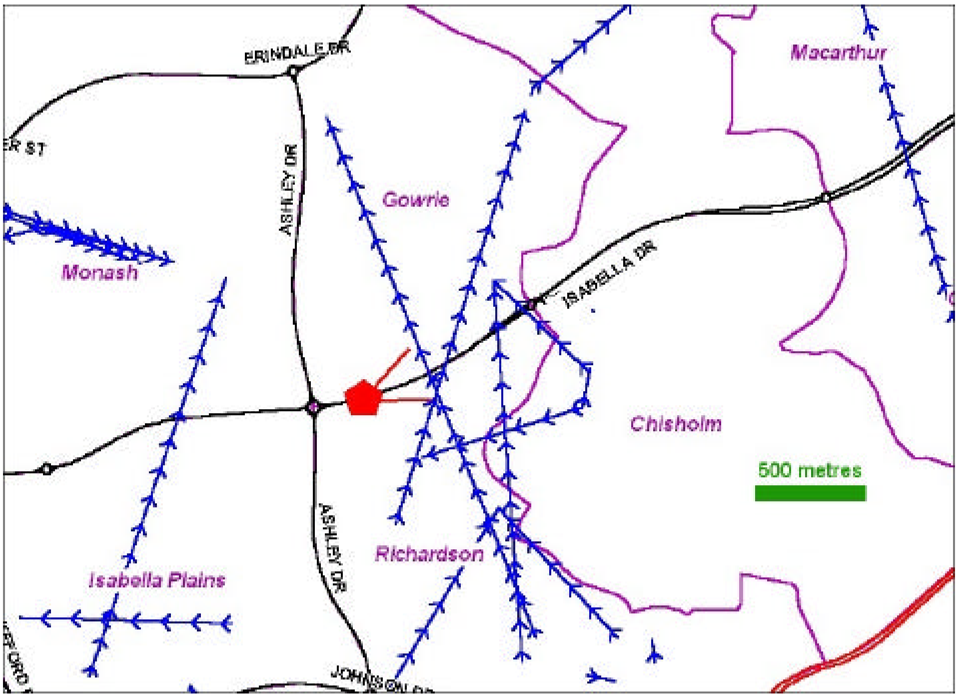
HINDMARSH DRIVE



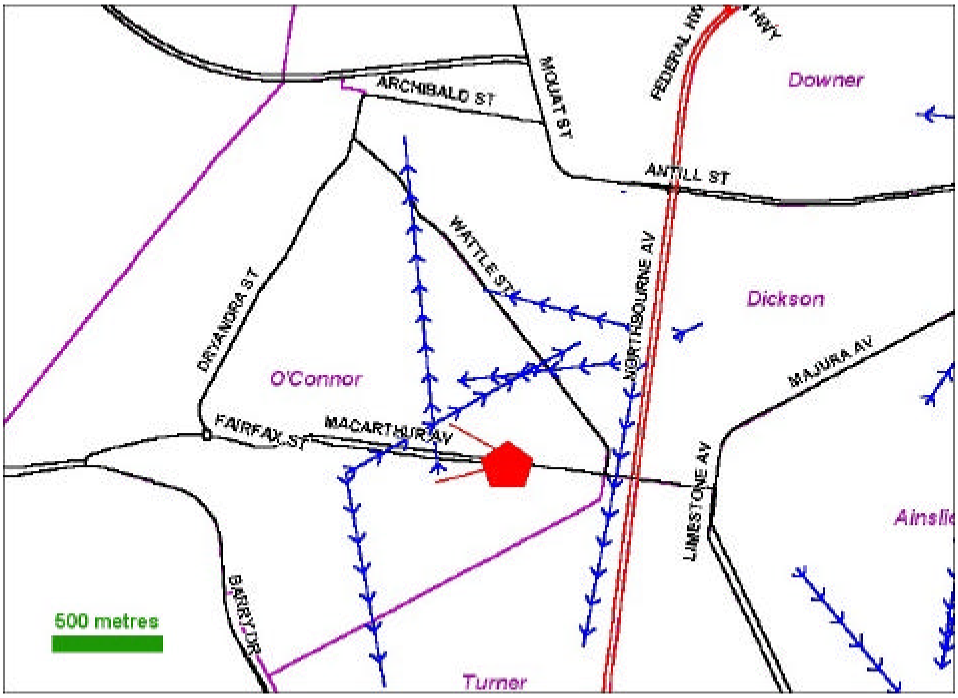
DRAKEFORD DRIVE



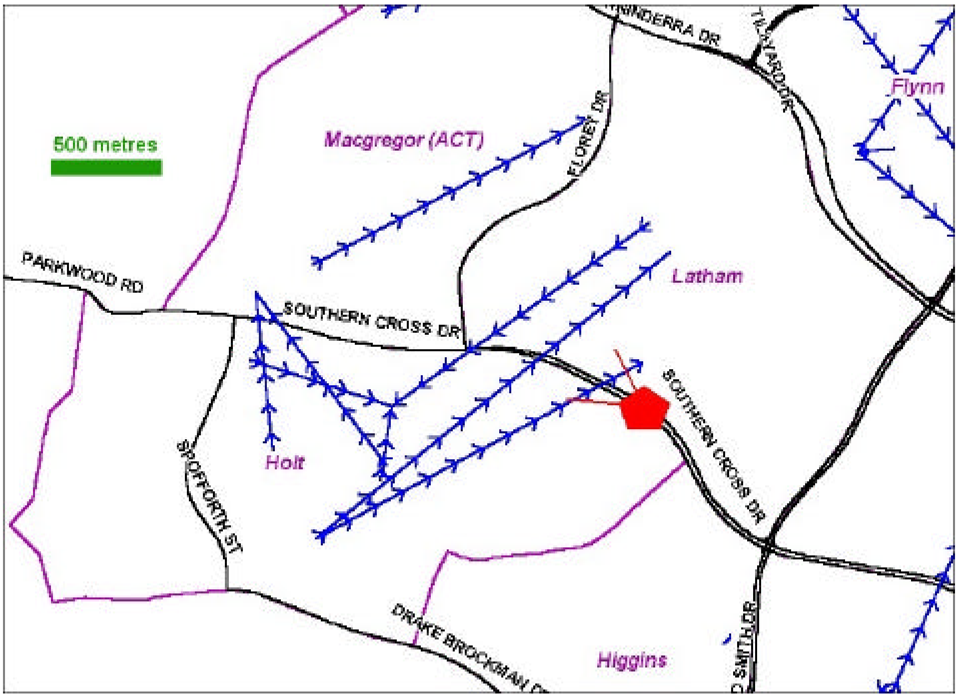
ISABELLA DRIVE



MACARTHUR AVENUE



SOUTHERN CROSS DRIVE



Appendix B: Distance, address, and urban geography regression data

Percentage of addresses in home suburb	Landmass in home suburb	Distance	Addresses generated
100	92.61163595	0.320251477	213
100	99.79906113	0.14027699	387
100	85.28077782	0.141445709	462
100	93.31240574	0.348628043	553
96.05263158	84.87645633	0.405622945	700
95.8974359	95.08191813	0.288866008	734
62.34177215	38.76230028	0.392358074	746
65.42288557	68.68035654	0.360199706	777
99.4949495	77.80835188	0.396238834	830
69.6969697	66.01054826	0.437581892	887
100	96.31410572	0.493175705	1008
100	99.14503615	0.492956615	1058
97.82608696	94.2548938	0.484514709	1118
99.00662252	90.82886316	0.509463793	1132
100	99.9284071	0.411057856	1201
65.13944223	65.05901133	0.541999478	1282
78.68131868	76.30734611	0.443680864	1291
94.21182266	90.39998298	0.523508531	1404
68.17447496	36.04100174	0.718260985	1409
97.04968944	96.71691638	0.521346178	1465
81.17816092	89.88756819	0.468697312	1506
93.47614411	86.38124674	0.693524381	1640
72.70168856	61.29459964	0.712402833	1703
82.04225352	75.43145432	0.615780663	1713
93.18681319	86.78432217	0.62499677	1762
54.5183714	51.42443433	0.64227885	1825
69.34548467	57.39681092	0.792928187	1828
73.88797364	66.08827676	0.71160713	1832
46.66666667	48.26736227	0.71328603	2069
70.58823529	65.552386	0.697453089	2125
95.93147752	92.76216202	0.885267356	2156
84.1453983	79.6647315	0.797593551	2210
59.20745921	51.14115537	0.827485551	2253
63.30837304	51.41045399	0.92641435	2371
58.68519508	56.9096351	1.032259616	2413
42.56880734	46.59758305	1.279585066	2476
83.08681672	59.24455089	1.011263615	2477
65.18072289	60.44552543	0.992039528	2489
95.95185996	86.33945686	0.863745884	2572
71.04913679	68.72963536	0.788448896	2636
61.46627566	66.27982787	0.977186651	2666
75.97796143	61.01092958	0.987514654	2751
82.1799308	78.13691144	0.980333665	2786
100	90.03696861	1.130173517	2983
74.58857696	74.35468716	1.042306242	3105
92.10394803	80.73052019	1.021710888	3202
71.76684882	59.39364638	0.948323148	3326
98.08590103	70.64238764	1.336437949	3341
76.9186382	33.84593461	1.691307675	3509
53.74625375	45.67754525	1.367643184	3544
28.56196156	45.27853311	0.732607527	3571

55.48172758	59.48977106	1.048149183	3584
27.4652548	37.38173319	0.764754262	3704
94.12582551	72.835575	1.322060666	3806
94.12582551	72.835575	1.322060666	3806
19.44315545	20.88463134	1.177974833	3912
72.86350749	68.74057948	1.025821703	3946
40.76257862	38.31755382	1.088913261	4028
59.84340045	32.43133037	1.514775868	4059
78.54558611	66.87403662	1.257976534	4178
28.10107198	27.46778546	1.119488728	4326
42.28056426	36.545466	1.272227481	4537
67.73809524	62.09580342	1.304533064	4634
67.73809524	62.09580342	1.304533064	4634
35.83051888	32.28821232	1.235595657	4791
39.96810207	29.71714513	1.708235082	4876
50.66045066	34.11467009	1.40831694	4885
55.51747772	49.57986087	1.168320971	4951
23.36835403	21.75706377	1.260096041	5009
41.41823444	27.82849904	1.489368447	5071
42.15902816	31.32318943	1.482015514	5152
38.46849563	28.63332754	1.753462917	5164
30.61026015	24.97916062	1.552398865	5432
30.10521282	18.25368798	1.816056859	5603
55.12241502	34.46945093	1.744239665	5614
80.33629145	74.58364721	1.392439929	5663
27.35717603	20.26019455	2.072727828	5719
37.46535651	39.64104092	1.360979787	5777
34.62714655	18.6510957	2.498250567	5800
30.00260213	28.09769257	1.384100154	5903
38.2439848	34.57827015	1.857862686	6490
27.62050497	29.4856254	1.560717417	6537
30.40430007	18.82412312	1.738052255	6667
19.85867005	15.76795404	1.853412685	6700
52.27848101	36.72862415	1.533248357	6748
26.3687367	17.73325128	1.825442948	6854
40.84215371	39.29014011	1.482700774	6915
45.84428716	43.2623242	1.59662235	7013
39.46759259	19.51065507	2.688689459	7463
18.15920398	24.42723536	1.377491926	7560
36.01201652	36.09159368	1.839469512	7801
27.17717718	29.30043052	1.933777972	7810
40.4924044	22.91425821	2.139964452	7861
20.37682077	19.31307968	1.533366644	8713
25.4000681	20.11035833	1.986286895	8724
22.98660493	22.07594646	1.795888554	8791
31.12936881	10.95847256	3.587774656	9878
16.99058795	17.14014176	2.035534903	10909
53.03604154	37.21873056	2.414131289	11212
26.38803775	16.54008112	2.78364467	11408
13.62770013	10.95035238	2.036324193	12247
51.96289905	39.71618246	2.337970904	13448
12.37535613	10.35951482	2.641004122	14156
18.33035486	16.31956943	2.627101405	14469
24.26091332	16.54741652	3.220792601	20292