REPEAT BURGLARY IN A PERTH SUBURB: INDICATOR OF SHORT-TERM OR LONG-TERM RISK?

by

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Abstract: *Two broad heuristic strategies have been employed to explain the success of prior burglary experience in predicting future burglaries. Event dependency explanations (Tseloni and Pease, 1997) assign a causal role to prior burglaries in influencing subsequent burglaries, whereas risk heterogeneity explanations interpret prior burglaries as mere "markers" of preexisting and more fundamental risk factors. This study of burglary in a small suburb of Perth, Western Australia, highlights the importance of long-term burglary risk factors operating on a small geographic scale, as well as the short-term influence of prior burglary events. Different mechanisms are required to explain repeat burglary in distinct but adjacent parts of the suburb. The study employs the Life Table method of survival analysis to examine the time course of repeat burglary and argues that survival methods provide a natural and well-developed statistical basis for the investigation of repeat victimisation.*

Recent crime prevention strategies have drawn heavily on research that indicates that the experience of past victimisation is a critically important predictor of future victimisation. For example, intervention strategies targeted at burglary victims have been successful in reducing both the number of repeat burglaries and the total number of burglaries in the target areas (Anderson and Pease, 1997; Forrester et al., 1990; 1988). These strategies are based on findings that burglary risks are elevated for one-time victims compared with the general population, and also that repeat burglaries follow each other in quick succession. Furthermore, intervention is directly related to the burglary event and entails a rapid response intended to circumvent the progression from initial to repeat burglary.

Other approaches to burglary research and prevention focus on risk factors associated with individual households and also with their residential areas (Jackson and Winchester, 1982). An important research finding is that crime victimisation can vary substantially from one small area to the next, so that an adequate analysis of burglary must examine risk on a small geographic scale (Bottoms et al., 1987).

This paper attempts to integrate the analysis of repeat victimisation with an analysis of the small-scale distribution of burglary in a suburb[1] of Perth,[2] the capital city of Western Australia. Burglary of a dwelling is a common property offence in Australia: one international crime survey indicated that Australia had higher rates of burglary with entry than the U.S., Canada and all of the European countries surveyed (van Dijk, Mayhew and Killias, 1991).[3] Furthermore, published crime data indicate that Western Australia has higher rates of burglary than any other state, whether measured by official police statistics (Australian Bureau of Statistics, 1996) or crime surveys (Australian Bureau of Statistics, 1994).

Since both the experience of prior burglary and the residential location of a household are important predictors of burglary, a joint analysis is necessary to assess their relative importance in the suburb of interest. The analysis addresses these issues through an exploration of the dimensions and time-course of repeat burglary. Repeat-burglary patterns are examined in the light of the background rates of burglary in the six collection districts[4] (CDs) that comprise the suburb. Key questions of interest are whether repeat offences are a cause or a consequence of elevated burglary risk, and whether the causal direction has consequences for burglary prevention.

PINNING DOWN BURGLARIES IN SPACE AND TIME: MEASUREMENT ISSUES

There are many reasons why crime surveys have grown in importance as a preferred means of crime analysis (Skogan, 1981). Crime surveys collect demographic and socioeconomic information about individuals and households that is not available in police records. Most importantly, surveys collect information from both victims and non-victims, enabling an assessment of the correlation of crime with factors such as age, sex, household structure, household income and so on. Indeed, the development and proliferation of crime surveys over the past 30 years has provided significant impetus for the analysis of differential risks of victimisation. However, crime surveys in their usual form are unable to specify the location of offences in space and time with high precision.

One problem with using survey data is that standard strategies used by survey analysts to address the influence on crime of places, areas and regions will almost certainly fail to capture the potentially large variations in crime at the small-area level. Bottoms (1993), referring to research he conducted with colleagues in Sheffield, UK, found that two adjacent areas — with populations between 2,500 and 3,000 — were indistinguishable on the basis of key sociodemographic variables such as sex, age, social class, ethnic origin, education or length of stay in current dwelling. Yet, these small neighbouring areas had a 300% difference in offender rates and a 350% difference in offence rates recorded by police.[5] The sampling strategies used in most crime surveys will be unable to identify differences on the scale detected in Sheffield. In surveys where sampling is directed at the national or city level, the sampling fraction generally is well below 1%.[6] Areas with populations of 3,000 could therefore be expected to contribute perhaps 10 to 15 respondents at most, of whom up to 3 may report a burglary. Real variations in offending at such small-area levels would be rendered invisible by the uncertainty, or "noise" induced by sampling error.

Small-area sampling strategies, such as those used by Bottoms (1993), can produce more precise survey-based spatial information about offences. However, survey users are presented with more intractable problems when they attempt to measure the distribution of burglaries over time. Using a retrospective approach, surveys typically ask respondents to recall victimisations that have occurred in the past 12 months. Research clearly indicates that respondents have difficulty in recollecting the precise timing and nature of all criminal events over a period as long as one year (Skogan, 1981).

Given the limitations of surveys, it is necessary for researchers to work with other sources of data if they are interested in allocating burglaries to very precise locations and time periods. Recorded crime or police calls for service are the only sources of data that are able to provide this level of spatial or temporal detail. Furthermore, for offences such as burglary and motor vehicle theft, there is evidence that police records may adequately reflect the number of offences occurring. Australian crime surveys find that respondents report over 90% of motor vehicle thefts, almost 80% of completed burglaries, but only one-third of attempted burglaries (Australian Bureau of Statistics, 1994). However, it must be acknowledged that no data source provides complete information about burglary and that the limitations of each source should be understood. In particular, it seems that the reporting of burglary incidents to police is not a random process, with repeat victims of burglary being less likely to report events to police than once-only victims (Guidi et al., 1997). If repeat-burglary victims have a lower propensity to report their incidents to police, then the analysis of police-recorded offences will underestimate the importance of repeat burglary relative to one-time burglaries.

BURGLARY RISK FACTORS

At the theoretical level, the analysis of the distribution of burglary risk needs to address a variety of factors. Bottoms (1994) draws together several general theoretical perspectives that push the spatial dimension of offence distribution to centre stage and are clearly relevant to the offence of burglary. Opportunity is a central concept, and this incorporates the attractiveness of household targets with regard to both the potential "payoff from a successful burglary and also the degree to which the dwelling may lack adequate surveillance. Furthermore, the routine activities (Cohen and Felson, 1979) of potential victims and guardians add an explicitly spatial dimension to the opportunity concept. Although the routine activities perspective has generally taken for granted the presence of motivated offenders, a consideration of the routine activities of offenders (Brantingham and Brantingham, 1991) furnishes further insights into the areas of a city that are familiar to offenders. These relate to their own daily routines and are anchored by offenders' places of residence, work, school, shopping or entertainment.

It is beyond the scope of this paper to consider these theoretical issues in detail. However, it is important to point out that the concrete findings about the influence of specific indicators of these factors on burglary have been somewhat contradictory. Bottoms (1994) cites the example of Wikstrom's research in Stockholm, which showed that burglary rates were highest in areas of high socioeconomic status (Wikstrom, 1990). These results contrast with the findings from many British studies indicating that burglary rates are highest either in or near socially disadvantaged housing areas. Smith and Jarjoura (1989) report similar contradictory findings with regard to the influence of income, race and residential instability on household burglary rates in three cities in the U.S. Their own study separates the individual- and neighbourhood-level influence of these and other variables with some success. For example, they find that burglary rates are higher in *neighbourhoods* with low average household incomes, but that *individuals* with higher incomes have a greater risk of burglary, controlling for the influence of neighbourhood. It is clear that one of the major issues in the prediction of burglary risk is the appropriate partitioning of individual- and area-level influences on the spatial distribution of burglary. However, for the purposes of this paper, it is sufficient to reaffirm the importance of residential location as a predictor of burglary, while acknowledging that some of the variation in area-level risk of burglary derives from unmeasured differences in risk factors at the level of the individual dwelling or household.

REPEAT BURGLARIES

One particularly important predictor of future burglary is past burglary. This predictor is measured at the level of the individual household, although it may be that the experience of a past burglary has less to do with the characteristics of the individual household or dwelling than with the attractiveness and accessibility of the surrounding area to potential burglars.

Initial interest in the analysis of repeat burglaries arose from the finding that the distribution of crime is disproportionately concentrated among a few victims. One analysis of the British Crime Survey indicated that 44% of all crime was concentrated among 4% of victims (Pease and Laycock, 1996). Concomitantly, the occurrence of one victimisation is predictive of further victimisation. Once-victimised households or persons are more likely to suffer a fresh victimisation than non-victimised households or persons. Pease (1993:326-327) observed that in the Kircholdt project "...the best single predictor of burglary victimisation was past victimisation." In Saskatoon, Canada, Polvi et al. (1990) found that households that experienced a first burglary were almost four times as likely as other households to experience a subsequent burglary. The conclusion that risks of victimisation are greater among those with a prior victimisation is not restricted to burglary. Similar results have been demonstrated for domestic violence (Lloyd et al., 1994), motor vehicle theft (Anderson et al., 1994) and racial harassment (Sampson and Phillips, 1992).

A more recent development is the finding that repeat burglaries are most likely to occur within a very short period of time following an initial burglary. Polvi et al. (1990) showed that the risk of repeat burglary was at its greatest in the first six to eight weeks after the initial burglary. Indeed, in the first month, the risks of repeat burglary were 12 times the expected rate.[7]

There has been a paucity of Australian research on repeat burglary, the exception being a study by Guidi et al. (1997). Using data based on calls for police service, the researchers examined patterns of repeat burglary in Beenleigh, Queensland, over an 18-month period. Their results indicated that 16% of victim addresses accounted for 32% of residential break-ins, and that the chances of a repeat burglary were double the overall chance of becoming a victim. However, these researchers found that the concentration of repeat burglary in Beenleigh was not as great as that found in studies conducted elsewhere (e.g., Farrell and Pease, 1993). Nevertheless, they concluded, on the basis of evidence from Australian crime surveys, that the true rate of repeat burglary was higher than found in their police data because repeat victims were less likely to report their burglary to police.

THE CONNECTION BETWEEN PAST AND FUTURE BURGLARIES

It is clear that prior burglary is a good predictor of future burglary. However there are two general ways in which this predictive power could arise (Tseloni and Pease, 1997). The first and most direct form of explanation is categorised by Tseloni and Pease as *event dependency*.* With event dependency, the risk of future burglary is raised by a prior burglary and there is a direct causal link between them. An alternative explanatory strategy is to argue that there is only an indirect connection between successive burglaries. The *risk-heterogeneity* explanation proposes that there are preexisting and stable risk factors that vary across the households of interest. These risk factors explain why some households experience one or more burglaries while other households are not targeted. With risk heterogeneity, the predictive power of prior burglaries arises because they are merely a convenient indicator of preexisting risk. Furthermore, if the factors contributing to this preexisting risk could be adequately identified and measured, they would stand alone as predictors of burglary. Prior burglary experience would add nothing to their predictive power.

Two additional points need to be made. First, these explanations represent extreme positions. Repeat burglary may be influenced by both event dependency and risk heterogeneity, and, therefore, both short- and long-term risk factors may be in operation. Second, there is no simple way to disentangle these mechanisms, but an examination of the time course of repeat burglary can furnish some clues. If the risk of repeat burglary is initially high but drops quickly within the space of several months, then this provides support for event dependency. On the other hand, a constant risk of repeat burglary over time provides support for the risk-heterogeneity explanation.

MECHANISMS FOR REPEAT BURGLARY

Risk-heterogeneity and event-dependency explanations provide a general framework in which to fit specific real-world mechanisms for repeat burglary. The repeat burglary research literature has emphasised event-dependency explanations that focus on the decision-making processes of offenders. Little emphasis has been placed on either risk-heterogeneity explanations or processes that involve the decisions made by burglary victims.

Bottoms (1994), after consultation with Pease offers three broad mechanisms to explain why multiple or repeat burglary should occur with higher-than-expected probability. The first explanation is that underlying opportunity factors explain why some premises are burgled initially and therefore why they are susceptible to further attack. Different burglars may independently burgle dwellings that are attractive from the point of view of a potential "payoff or ease of access. Note that, consistent with the earlier discussion of risk factors for areas and for individual households, the opportunity factors described above may be connected with either individual or area vulnerability. Furthermore, one way of assessing the dimension of opportunity is to measure the background rate of burglary in the area of interest.

The risk-heterogeneity explanation is ultimately rejected by Bottoms (1994) on the grounds that the opportunity mechanism is not consistent with findings about the distribution of elapsed times between successive burglaries, these being heavily skewed towards early repeats within the space of one or two months. Nevertheless, the rejection of the opportunity mechanism may be premature in the absence of adequate consideration of preexisting risk factors and appropriate tools of analysis (Spelman, 1995). Furthermore, it is likely that different locations within a country or across the world will vary in the mixture of their mechanisms accounting for repeat burglary.

The second mechanism identifies repeat victimisation with repeat offending. Its hypothesis is that the same offender(s) return and commit further burglaries.

The third mechanism assumes that there is communication between burglars. The original offenders may discuss the burglary, the dwelling and its contents with others, who in turn commit a later burglary. Mechanisms two and three are *event-dependent* explanations and receive support from the findings of research conducted in Cambridge by Bennett (1995).

Bennett's (1995) interviews with convicted burglars confirmed that many Cambridge burglars did return to the same dwelling,[9] and that almost half of them had committed a burglary as a result of first-hand information from other burglars. The reasons given by offenders for returning to an earlier burglary target covered a range of factors, such as low risks, high rewards and ease of access, while the reasons given for acting on "tip-offs" focussed mainly on their perceived rewards. Other authors have presented a variety of reasons for the attractiveness of committing repeat burglaries (Farrell et al., 1995). However, on the basis of offences reported to police, it is not a simple task to assign any instance of repeat burglary to one or other of these categories. Given that burglary clear-up rates are low, inferences about the mechanisms for repeat burglary are almost always indirect and apply to repeat burglaries in aggregate, rather than to individual cases.

USING REPEAT VICTIMISATION STRATEGIES TO PREVENT CRIME

The analysis of repeat victimisation has assumed increasing importance for a number of reasons relating to both the distribution of crime and the strategic allocation of crime prevention resources. Given that any crime prevention effort will be subject to resource limitations, the repeat victimisation strategy promises a means of targeting scarce resources at those who are at most risk of future burglary and who, therefore, are most likely to benefit from them. The repeat victimisation strategy represents a well-articulated attempt to incorporate the assessment of future victimisation risk into a broad set of considerations for promoting effective crime prevention. 10

If one-time victims are at heightened risk of future victimisation, that fact may be used to target crime prevention activities in a very specific way. However, perhaps the clearest and most direct presentation of the benefits of such a strategy is to be found in Pease (1993), who was concerned with the findings of British research indicating that crime prevention resources were being allocated in inverse proportion to recorded crime rates. Pease (1993) argued that a repeat victimisation strategy would realign crime prevention activities in the following way:

- Because it is based on a careful examination of the individual circumstances of crime, the repeat victimisation strategy will tend to involve all the appropriate measures, both social and physical.
- Preventing repeat victimisation protects the most vulnerable social groups, without having to identify those groups as such, which can be socially divisive. It is arguable that the prior expe-

rience of victimisation represents the least contentious basis for any allocation of crime prevention resources.

- Repeat victimisation is highest, both absolutely and proportionately, in the most crime-ridden areas, which are also the areas that suffer the most serious crime. The prevention of repeat victimisation *automatically* directs attention to the areas that need it most, rather than the converse, as is now the case.
- The rate of victimisation offers a realistic scheduling for crime prevention activity. Preventing repeat victimisation is a way of "drip feeding"" crime prevention.
- In England and Wales, the strategy addresses the way in which inequality of victimisation rates has changed during the period covered by the British Crime Survey.
- In high-crime areas, a focus on repeat victimisation is readily converted into a community initiative. The advantage over conventional community approaches to crime is that the initiative is rooted in real events suffered by citizens.

Other authors, including Bridgeman and Hobbs (1997), Pease and Laycock (1996), Anderson et al. (1994), the National Board for Crime Prevention (1994), Farrell and Pease (1993), and Forrester et al. (1988), and have argued that additional advantages accrue:

- Crime prevention efforts and victim-support activities are brought together through a focus on victims in a way that offers practical help to avoid future victimisation.
- For police, a useful link is provided between crime detection efforts and crime prevention activities. Crime prevention and "mainstream" police activities are brought closer together.
- Interagency cooperation and coordination are focussed on individuals, for example, in enabling housing authorities to liaise with police in providing better physical security for its building stock.
- The fact that a victimisation has already occurred increases the salience of crime prevention. One-time victims are more likely than other citizens to take self-protective action. Furthermore, if the "time course* of repeat victimisation is known to be short, and if this is communicated to victims, an appropriate sense of urgency may be associated with the implementation of these protective activities.

It is clear from these comments that the focus on repeat victimisation is seen as more than just a response to an empirical distribution of crime. Advocates of this approach point to its advantages as a defensible distributive principle for the allocation of resources, from the perspectives of justice, effective and efficient use of resources, and reorientation of police activities. Importantly, the approach is seen as a way for crime prevention activities to keep a concrete focus and to avoid being sidetracked by matters extraneous to their primary task.

SOME TOOLS FOR ANALYSIS

Although repeat victimisation has been investigated for many years, the tools for its analysis have yet to be perfected. These comments apply particularly to the analysis of the time-course of repeat burglary, and there are several reasons why this has presented repeat burglary researchers with analytic problems. Typically, researchers have access to 12 months of burglary data and must investigate patterns of initial and repeat burglary within this window. A 12-month window imposes severe constraints on the length of follow-up time available for a repeat burglary to take place, particularly when the first observed burglary for a dwelling occurs towards the end of the window. For example, if the first burglary occurs in month 11 of the window, there is only one remaining month in which a repeat burglary can be observed. A repeat burglary occurring more than one month later will be invisible to researchers. This situation may be contrasted with that for households where the first burglary is observed in month 1 and there is an 11-month follow-up period. Differences in observation periods for burgled households mean that the unadjusted distribution of elapsed times between successive burglaries is a biased indicator of the risk of repeat burglary at any given time point, and the bias is in favour of shorter elapsed times.

The problem is further understood by examining some of the strategies used to correct the bias. Johnson et al. (1997) tested the time course of repeat burglary in Liverpool, UK by using only households where initial burglaries occurred in the first six months of their data set. All of these households could then be followed up for a repeat burglary for a minimum of six months. There is a statistical "cost" to this approach, however, since all households burgled for the first time in the second six months of the window have to be ignored. Furthermore, useable data on the risk of repeat burglary at time periods longer than six months are ignored because this method has no means of correcting their bias.

Two other approaches to the problem of bias are discussed by Pease and colleagues and are presented clearly in Appendix 1 of Anderson et al. (1995). The simpler approach, when elapsed times are available in months, is to apply a statistical adjustment, or weighting, to each monthly estimate of the elapsed time to repeat burglary. Anderson and colleagues give an example of the use of this adjustment for an 11-month observation period for burglaries in Huddersfield, U.K. The final strategy is described in Polvi et al. (1991). With this approach, the risk of repeat burglary is expressed as a ratio of the observed-to-expected number of repeat burglaries in each follow-up month, the expected number being determined on the basis of calculations using the Poisson distribution. Anderson and colleagues believe this approach to be the most satisfactory from a statistical point of view.

A further issue is whether to base analyses on burgled households or on burglary events. In their Huddersfield study, Anderson and colleagues (1995) chose the burglary event rather than the household as the unit of analysis. This approach allows one repeatedly burgled household to contribute a number of points to the analysis. Alternative approaches would be to allow only one repeat burglary; the first, for example, to be included, or to include all points, but with weights inversely proportional to the number of burglaries contributed by each household. The favoured approach would seem to depend on the focus of the analysis. If the impact of the first burglary is of interest, then only the follow-up time to first repeat should be chosen. Furthermore, if there is interest in the cumulative proportion of households that suffer a repeat burglary, then only the first repeat burglary should be included, in order to preserve a simple interpretation of the cumulative fraction of the sample who are revictimised after specified time periods. On the other hand, if the principal interest is on the influence of any burglary on the next, then all burglary events should contribute to the data.[11] It would be a valuable exercise, in any case, to check if the alternative approaches make any substantive difference to the analysis.

Repeat burglary researchers have struggled to develop satisfactory methods for the analysis of its time-course. However, another criminological field — recidivism analysis — addresses almost identical problems from the point of view of the offender and has made significant methodological progress in the past 10 to 15 years. Recidivism research has adopted various forms of survival analysis as standard techniques for examining the time-course of repeat offending (Mailer and Zhou, 1996; Broadhurst and Loh, 1995; Tarling, 1993; Chung et al., 1991; Schmidt and Witte, 1988; Maltz, 1984). Yet few studies of repeat victimisation have used survival modeling with its associated concepts of the hazard rate and of "censored" events. A clearer view of the patterns of repeat victimisation is available through the use of this analytic tool. Spelman's (1995) study of calls for police service at fast-food restaurants in San Antonio, Texas, seems to be the only published research using the methods and concepts of survival analysis for the investigation of repeat victimisation. A detailed explanation of survival analysis methodology is not attempted here, given the availability of many excellent treatments (see above). However, some aspects of the method will become evident in its application to Perth burglaries.

A key measure in survival analysis is the *hazard rate* — the probability, in repeat burglary terms, that a household that has not experienced a repeat burglary to date will suffer a burglary within the next unit of time. The hazard rate accurately indicates the risk of repeat burglary at any point of time. Survival analysis procedures produce estimates of risk that have many appealing features. In particular, they are unbiased, have a simple and direct interpretation, make use of all data collected, and allow standard errors of estimates and confidence intervals to be generated.

In this study, the form of survival analysis is the Life Table method. Life Table analysis is a simple non-parametric technique available in SPSS and other statistical packages. The method is used in two separate stages to illustrate the short- and long-term time patterns of repeat burglary risk.

THE CURRENT STUDY

This study examines the patterns of burglary and repeat burglary in "Parkville,"[12] a residential suburb with a population of approximately 2,000 and a dwelling stock of 1,000 units. Parkville consists of six CDs. The area has a varied mix of housing types, household incomes and crime rates; some of these characteristics are summarised in Table 1. The six CDs differ markedly in their apparent attractiveness for potential burglars, and in the degree to which their physical features and patterns of activity provide a sense of guardianship or surveillance. The two CDs with the highest burglary rates consist mainly of detached dwellings on fairly large allotments. These areas contain the major access pathways to public transport in the suburb and are criss-crossed by a series of alleys providing rear access to dwellings. The other areas contain a high percentage of flats, units and semi-detached dwellings, few alleys and fewer well-trodden paths for vehicle and pedestrian usage.

The data consist of five years of police-recorded burglaries and attempted burglaries, with information available about the dates and times of these events, their addresses and the value of any goods stolen. The Parkville burglary database covers an unusually long observation period in comparison with previous studies, and supports an analysis of trends in the area over time and an examination of both short- and long-term patterns in repeat burglary. Supporting these police data is an address database for the area, assembled by the researcher through personal inspection. Information is available about the dwelling units attached to any street number. For example, a street number may refer to a single unit or a block of eight units, and some addresses may be invalid or incomplete.[13] The address database allows for checks to be made on the adequacy of addresses recorded by police.

For the purposes of this study, repeat burglary occurs when any dwelling unit is subject to more than one burglary over a five-year period. No attempt was made to check whether the same or different householders were present at the time of the later burglary. In some cases (less than 10% of burglaries), it was impossible to identify the precise dwelling unit burgled at multiple unit addresses. In such cases a dummy unit number (zero) was created at that address. This procedure creates the possibility of either under- or over-counting repeat burglaries. For example, two burglaries at the dummy addresses will be counted as repeats, when they may have involved different units. On the other hand, consecutive burglaries in the dummy unit and a valid unit number may have been unidentified repeat events that were not identified as such for lack of information. For Parkville as a whole, the problem is not as significant as it might have been because multiple addresses had very low rates of burglary compared with single unit addresses.[14]

In the main analysis of repeat burglary in Parkville, the six CDs are amalgamated into two areas with respectively high and low burglary rates.[15] For convenience, these are labeled Oldville and Newville since, in terms of dwelling construction, Oldville consists mainly of dwellings built in the 1930s and 1940s, whereas dwellings in Newville were constructed from the 1950s onward. The decision to amalgamate the CDs into larger areas was taken in order to provide a sufficiently large statistical base to undertake the analysis of repeat victimisation. It is clear from Table 1 that there is some variation in burglary rates in the four CDs within Newville. However, the major break in rates occurs between the CDs in Oldville and those in Newville. Differences between these two areas are significant enough to illustrate the importance of risk heterogeneity in the analysis of repeat burglary.

Table 1: Selected Characteristics of Parkville Collectors' Districts

	Dwelling type[a].			Household Income[a]		Burglary rate
CD name[b]	Percent units or flats	Percent semi-detached dwellings	Percent separate house	Percent household income >$40,000	Percent household income <$12,000	(Annual rate per 100 dwellings)
Edgebourne	86	2	12	14	38	3.18
Seventies	4	30	65	45	9	5.88
Newtown	89	3	8	4	37	7.43
Flat city	83	15	2	19	34	1.67
Oldtown	2	14	85	48	12	14.76
Gateway	4	4	93	34	5	12.86

a. Data taken from the 1991 Australian Census.
b. All collectors' district names are fictitious.

Stability of Rates over Time

Figure 1 illustrates clearly that burglary rates for Parkville did not change substantially between 1991 and 1995. More importantly, the differences in burglary rates between Oldville and Newville were also stable over the five-year study period. They were not the result of transient effects creating temporary "hot-spots" of burglary. Over all, Oldville's annual burglary rate was 3.2 times the rate of Newville's, and the burglary rate ratios varied between 2.2 and 4.7 in individual years. Another way of comparing the areas is to note that Oldville's two CDs contained just over a quarter of the dwelling units but accounted for 55% of the burglaries. These results mirror Bottoms's (1993) findings of markedly different crime rates between adjacent small areas in Sheffield.

Initial and Repeat Burglary Rates

Table 2 compares the annual prevalence and incidence of all burglaries in Parkville with the prevalence and incidence[16] of repeat burglary. The measures for repeat burglary are adjusted to take account of time at risk and are converted into annual rates. For example, if a burglary is committed at 5 Long Street on 31 December 1991, that address is at risk of one or more repeat burglaries for a four-year period. On the other hand, if the first burglary occurs on 31 December 1994, it would only be at risk for one year. Table 2 illustrates the following patterns:

(1) The risk of burglary among once-burgled dwellings is higher than the overall risk of burglary for both Oldville and Newville.

(2) Repeat burglaries reproduce the same ranking as do total burglaries. In other words, they are more likely to occur in Oldville than Newville.

(3) However, in relative terms, repeat burglary is more significant in Newville than it is in Oldville. In other words, the ratio of repeat burglary rates to overall rates is greater in Newville than in Oldville.

(4) Differences between Oldville and Newville in repeat burglary rates are smaller than differences in their total burglary rates, both in ratio and absolute terms.

Figure 1: Parkville Burglary Rates By Year and Area

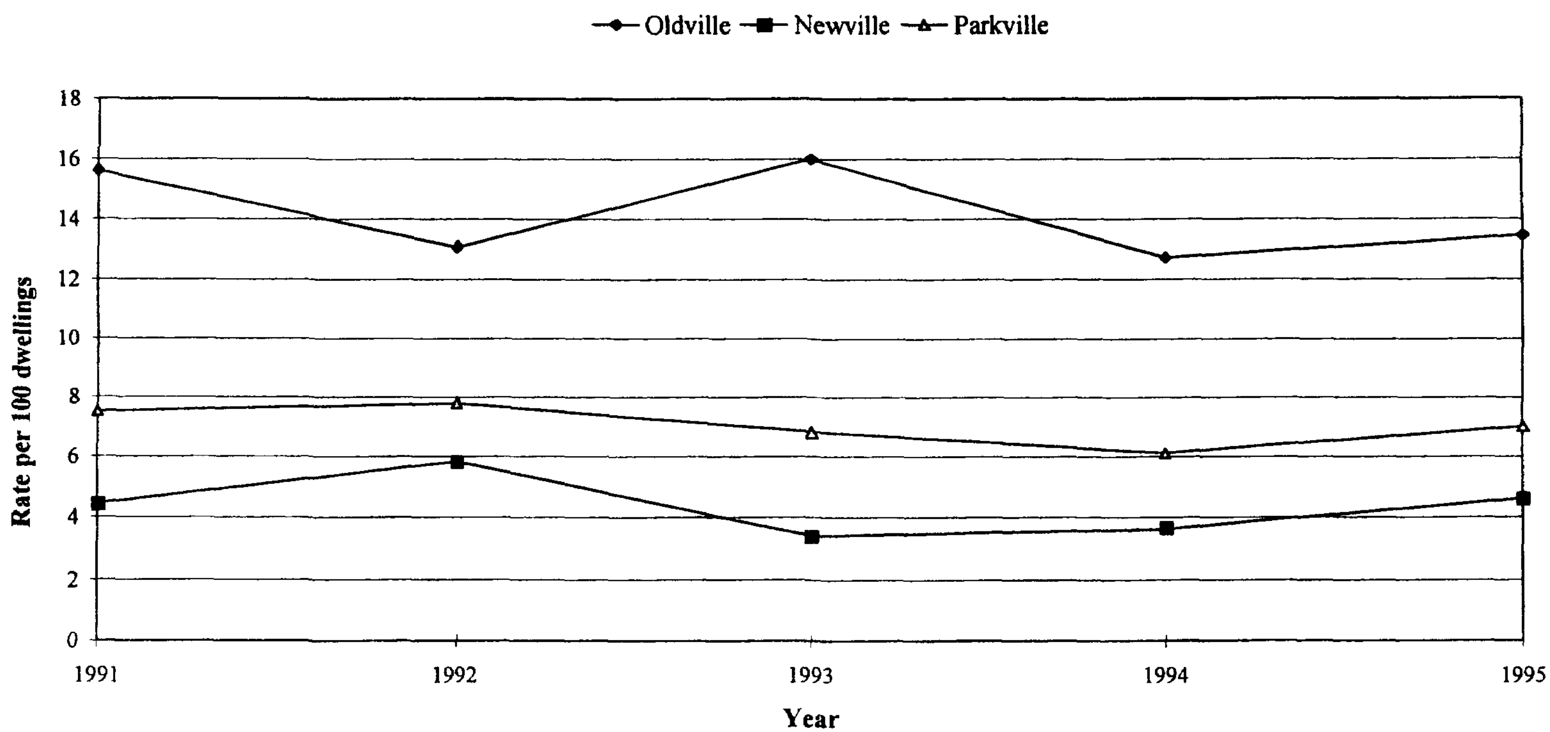


Table 2: Total and Repeat Burglary Rates in Parkville

Area	Total dwellings	Total burglary rate[a]	Repeat burglary rate (adjusted)[b]	Ratio of repeat to total rates
Oldville	275	14.18	20.71	1.46
Newville	735	4.41	12.00	2.72
Parkville	1,010	7.07	16.45	2.33

a. Rates are calculated on an annual basis as the number of burglaries per 100 dwellings per year.

b. Adjustment takes into account the time during which any burgled address is at risk of repeat burglary.

Table 2 examines the whole five-year burglary window in Parkville and its sectors. At this small scale of analysis, the findings appear at first glance to be opposed to some of the findings arising from research conducted in the U.K. Results (1) and (2) above are consistent with the literature: that burglary victims are at increased risk of later burglary compared to non-victims, and rates of repeat burglary are higher in the area(s) where background rates of burglary are high. On the other hand, Table 2 points to the importance of repeat burglary to victims in low-burglary rate areas relative to their expected risk. Furthermore, burglary victims from high- and low-risk areas appear to converge in their likelihood of future burglary when compared with their burglary-free neighbours. The repeat victimisation literature has been silent on these issues. However, one study by Osborn et al. (1996) has produced findings consistent with these Perth results, and will be discussed in the final section of this paper.

The next objective is to examine the time-course of repeat burglary using survival analysis. Time patterns of repeat burglary risk provide valuable clues to understand the mechanisms of repeat burglary. In particular, they may be expected to provide support for either event-dependency or risk-heterogeneity explanations.

A Life Table Analysis of Repeat Burglary in the First Year of Exposure

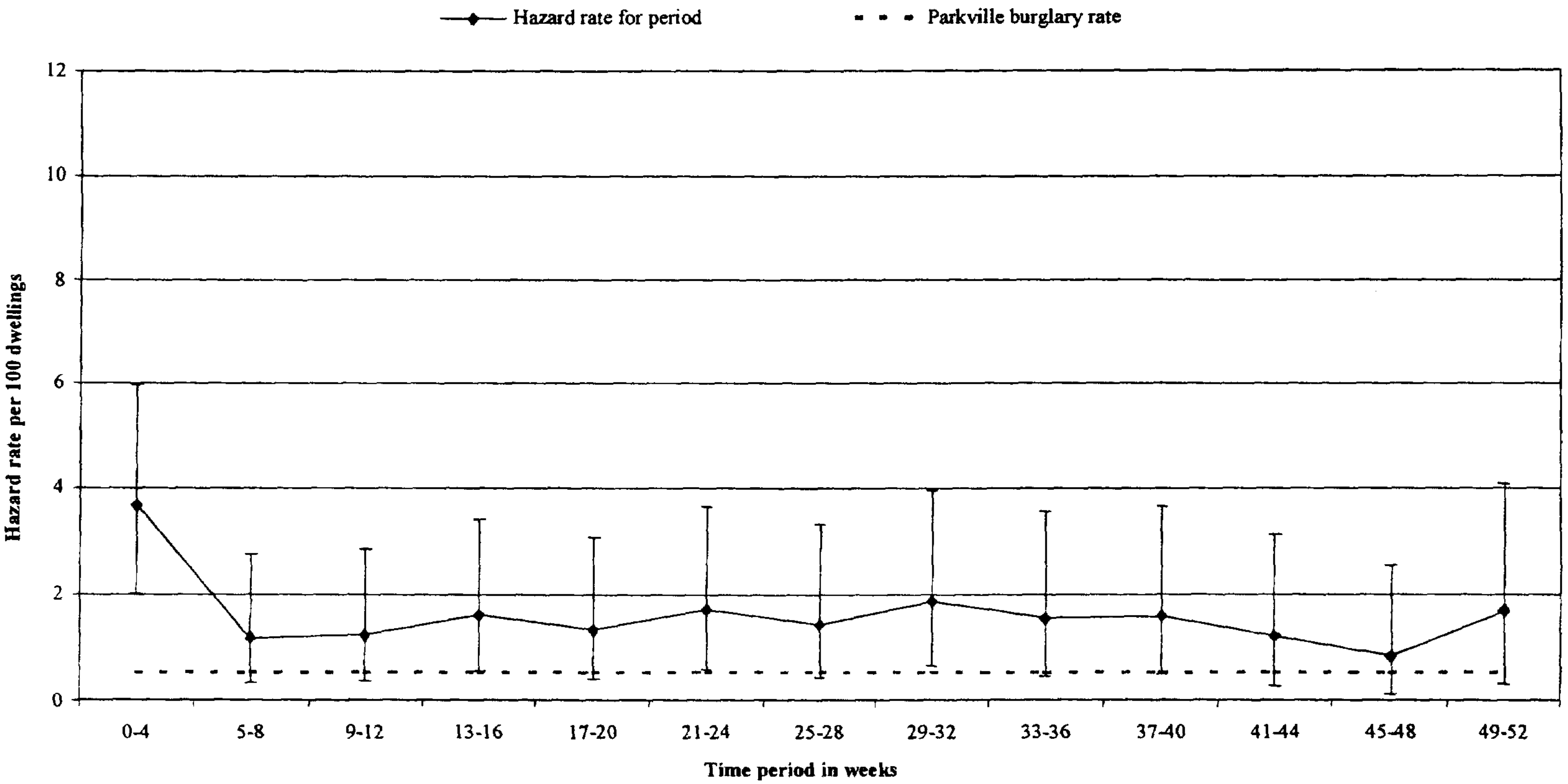
A simple form of survival analysis is the non-parametric Life Table method, the assumptions of which are relatively transparent and simple, and are described in the SPSS manuals (for example, Norusis, 1990). A key feature of all survival models is that they control for the length of follow-up period in which subjects are at risk of failure. (See the above discussion on adjusted burglary rates.) Survival analysis models estimate the risk of "failure" for any time period up to the maximum time at risk. The risk of failure at any time point is called the *hazard rate.* In a Life Table analysis that uses one-month time periods to assess risk, a hazard rate at six months represents the probability that a dwelling that was burgled six months earlier, and has not yet experienced another burglary, will suffer a repeat burglary in the following month.

For example, some dwellings in our research study were burgled in January 1991 and were at risk of a repeat burglary for almost five years. Other dwellings were first burgled in December 1995 and were at risk of a burglary for less than a month. Survival methods allow all of these dwellings to enter into the analysis in an appropriate way. The dwellings burgled in December 1995 can be included in the analysis for the first month of follow-up. They then drop out (they are "censored" according to the terminology of survival analysis) of longer-term analyses since they were simply not at risk for longer periods. On the other hand, dwellings burgled in January 1991 can potentially be included in the estimates of repeat burglary risk for the whole five-year period, since they were at risk for all of this period. Survival analysis models estimate the risk of failure in an unbiased way for any time period up to the maximum time at risk. For the Parkville data, estimates of the hazard rate at longer periods of time are subject to greater standard errors because they are based on smaller numbers of households that are not censored and that do not suffer a repeat burglary.

The SPSS Life Table analysis procedure is flexible in the setting of particular parameters of model fitting. In the Parkville data set, the gap between burglaries is available in days and the hazard rates for the first year of exposure were calculated in periods of 28 days. This is a satisfactory setting for examining the hazard rate over a period of one year, but less satisfactory for longer periods. Longer-term hazard rates are estimated by using units of exposure of 12 weeks (84 days) in a second stage of the analysis. Since the hazard rate is found to decrease over time, the use of longer time units of exposure is necessary for more statistically reliable estimates of longer-term hazard rates. The 12-week unit was able to produce hazard rate estimates up to a follow-up time of 168 weeks — or just over three years.

Figure 2a shows, for the whole suburb of Parkville, the hazard rates for repeat burglary together with their 95% confidence intervals for a period of one year (13 periods of 28 days). Only the first period shows evidence of an elevated risk of repeat burglary. While there is

Figure 2a: Parkville Repeat Burglary Hazard Rates and Confidence Intervals in 4-week Follow-up Periods



some variation in hazard rates after this, these are within the measured ranges of statistical variation. Taken alone, this analysis of the risk of a repeat burglary points to an elevated risk in the first month, after which the risk reverts to a relatively constant level. A statistical test to check whether or not the hazard rates from the first and second time periods come from the same binomial distribution reveals that they do not. The difference between the two rates is significant (Chi-square=4.6, df=l, $p<0.05$), and there is little overlap between the confidence intervals for the two hazard rates. Superimposed on the hazard rate plot is the background five-year burglary rate for Parkville, plotted on the same scale as the hazard rate. This provides a convenient benchmark by which to assess the repeat burglary rates. The repeat burglary hazard rates exceed the Parkville burglary rate for every period in the first year of re-exposure.

The relationship between these hazard rates for 28-day periods and the suburb burglary rates are consistent with the full five-year analysis summarised in Table 2. However, the survival analysis for Parkville highlights the first time period as being of particularly high risk. This is followed by relative constancy in risk for the remainder of the first year. Figure 2a presents hazard rates in terms of the proportion of households suffering a repeat burglary in each 28-day period. It also displays 95% confidence intervals for hazard rates, using the SPSS output data on the number of repeat burglaries in the interval and the average number of households at risk. Likelihood-based confidence intervals are calculated using a method described in Aitkin et al. (1989).

The SPSS Life Table output for the first time period helps to illustrating the methodology of this survival procedure. At the beginning of the period 357 households, the data set for all burglaries, were at risk of a repeat burglary. During that period seven observations were censored. These represent those households who experienced a burglary less than 28 days before the end of the five-year follow-up period and were therefore at further risk for less than a month. The seven censored observations are assumed to be withdrawn evenly over the time period, averaging 3.5 fewer dwellings at risk over all. In total, the procedure estimates that an average of 353.5 (=357-3.5) observations were at risk. In the same period there were 13 repeat burglaries, assumed to occur at the end of the time period. The hazard rate is then calculated as 13/353.5, or 0.0368. Since seven observations are censored and 13 "terminate," there remain 337(=357-7-13) observations entering the next time period.

Figures 2b and 2c throw more light on the dynamics of repeat variation within the suburb. Figure 2b shows the hazard rates for Newville and is in marked contrast with the picture for Oldville displayed in Figure 2c. Once again, the figures display the background burglary rate for each area. Newville shows a very high risk of repeat burglary in the first month followed by low risks of a repeat for the remainder of the year. As expected, the hazard rate for the first and second time periods are significantly different (Chi-square=8.02, df=l, p<0.005). Oldville, on the other hand, shows no sign of an elevated risk of repeat burglary in the first month, and while there are apparent differences in risk in later months, these are not statistically significant. Figures 2a, 2b and 2c are drawn to the same scale and they show clearly that, in absolute terms, the *hazard* rate for a repeat burglary in Oldville is greater than in Newville's for almost all of this 12-month follow-up period. However, against this general pattern, the rankings are reversed in the first period, leaving Newville households in the first month with the highest hazard rate for repeat burglary in either area for any 28-day period.

This time-course of repeat burglary evident from the Life Table analysis is consistent with the frequency analysis presented in Table 2. In Oldville the repeat burglary rate is greater than in Newville. However, relative to the overall burglary rate for the area, repeat burglary is more important in Newville, and it is clear from Figure 2b that the spike in repeat burglary risk is high but temporary. Little difference is observed in the time-course of repeat burglary if attention is restricted to the first repeat burglary, rather than all repeats. Most importantly, the high initial rate of burglary in Newville is not due to multiple burglaries at one or two high-risk households, so the strategy of analysis does not appear to be a critical factor. What is more important, however, is the high proportion of rapid repeat burglaries at multiple unit addresses, some of which were allocated dummy addresses as already described. The appearance and significance of these addresses will be discussed later.

Life Table Analysis for Exposure Periods up to Three Years

Figure 3a displays the results of the Life Table analysis for Parkville in the longer term. Thirteen exposure periods of 12 weeks stretch the coverage of the hazard rate analysis out to a time frame of more than three years. To aid the comparison with figures 2a, 2b and 2c the hazard rates are presented on the same scale. They represent

Figure 2b: Newville Repeat Burglary Hazard Rates and 95% Confidence Intervals in 4-week Follow-up Periods

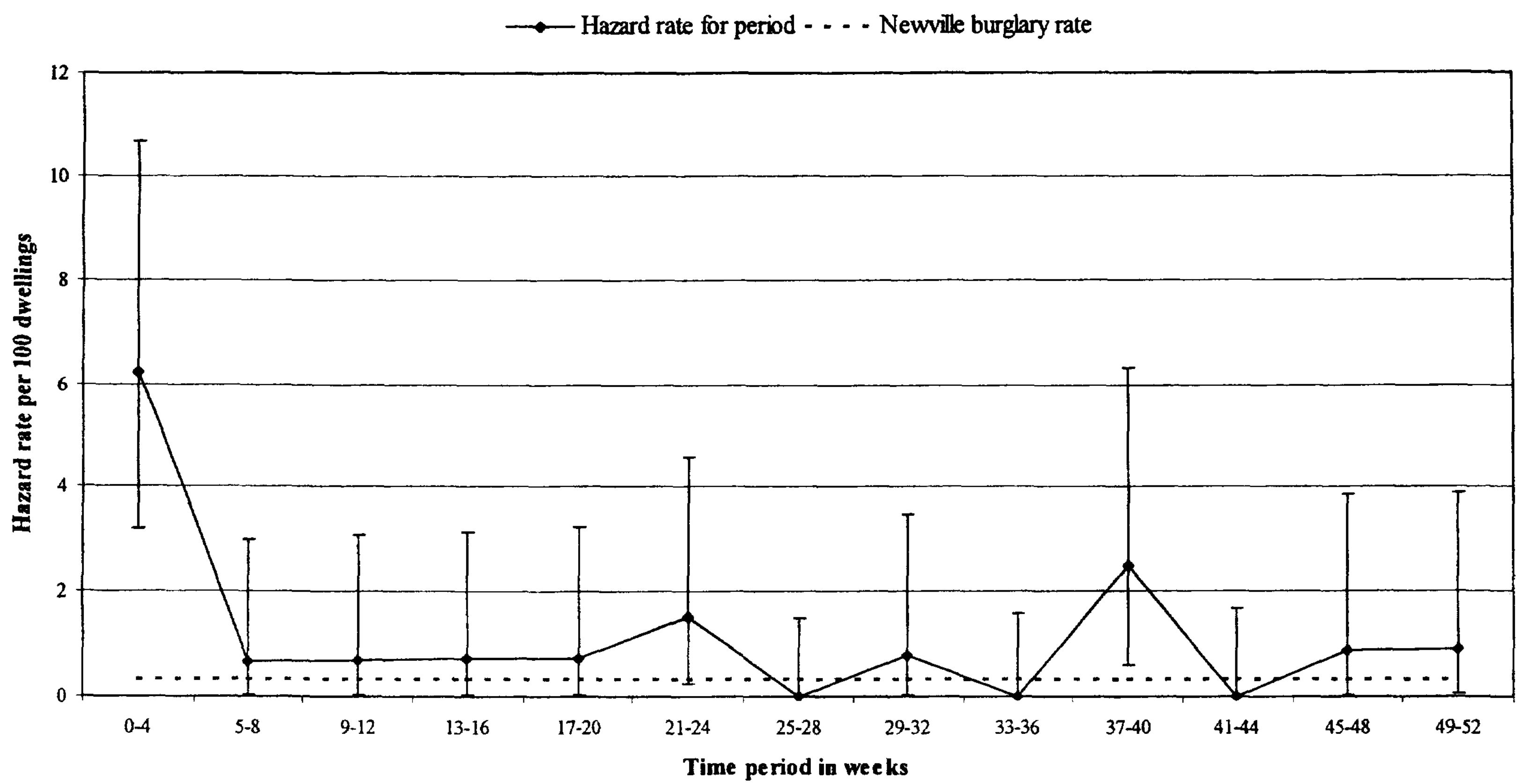
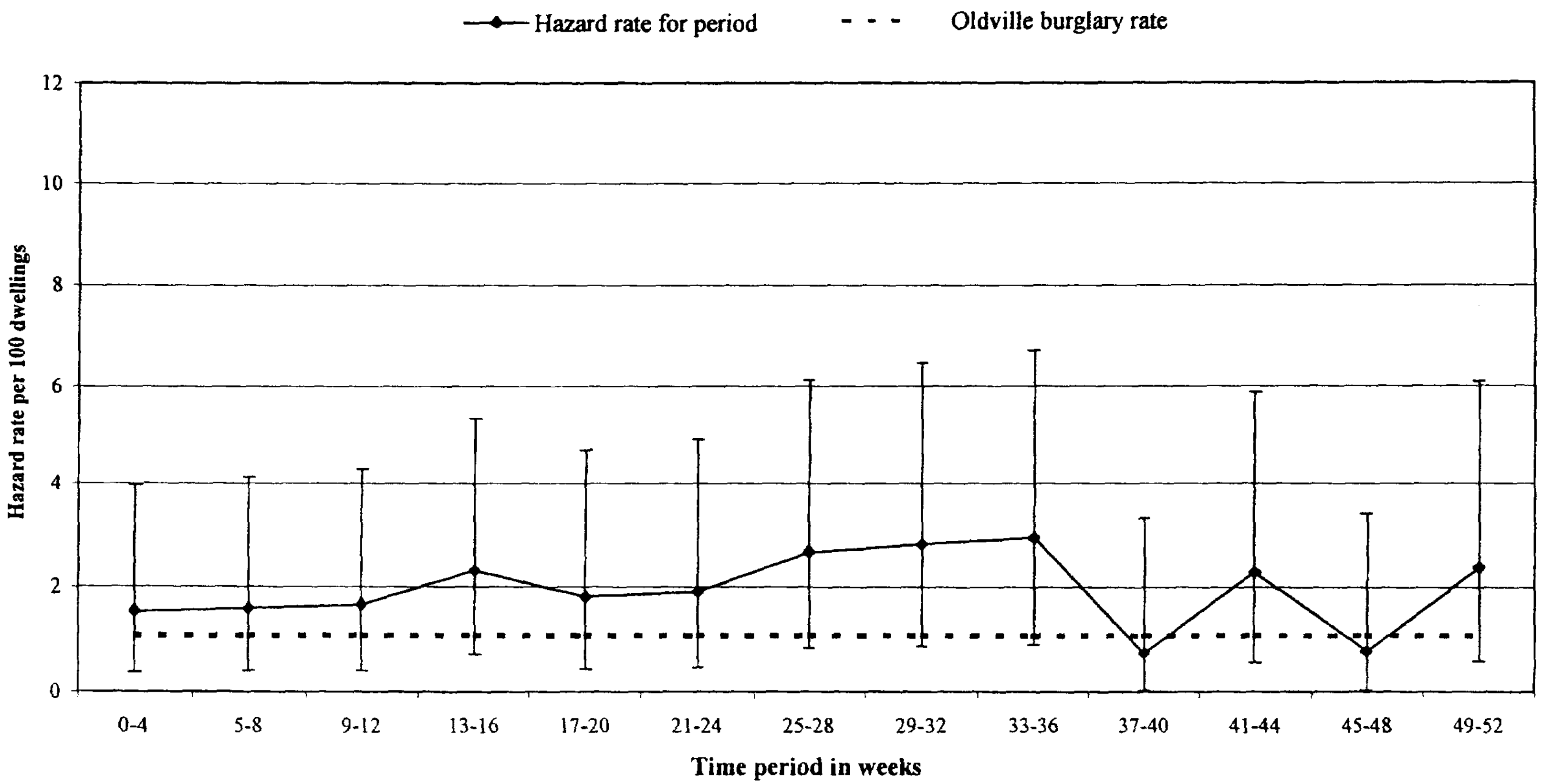


Figure 2c: Oldville Repeat Burglary Hazard Rates and 95% Confidence Intervals in 4-week Follow-Up Periods



the number of dwellings out of every 100 that experience a repeat burglary in 28 days. The repeat burglary hazard rates for Parkville appear to decline up to 132 weeks. At the end of the coverage, they decrease to the background burglary rate for the suburb after being well above it initially. The continuing decline in hazard rate is difficult to explain in terms of repeat offending, since most discussion has focused on repeat offending mechanisms that operate within a time frame of several months. However a careful analysis of the Life Table analyses for Newville and Oldville in Figures 3b and 3c provides some clues as to a source of this continuing decline. While statistical variation in hazard rates for Newville and Oldville makes analysis somewhat difficult, there is little evidence of continually declining hazard rates over time.

A plausible explanation for the Parkville pattern lies in the mixture of high-risk and low-risk households that constitute the suburb. The high-risk Oldville households are more likely to experience a repeat burglary and to drop out of the analysis in the early stages of follow-up. This means that at longer follow-up times, the mix of dwellings exposed to repeat burglary will contain relatively more from Newville than Oldville. The SPSS Life Table output confirms that this is so. It indicates that the median time to repeat burglary in Oldville is 1,289 days, while for Newville it is over 1,820 days.[17] The declining Parkville hazard rate is at least partly caused by risk heterogeneity, which ensures that high-risk households are burgled quickly and drop out of the analysis, while low-risk households remain.

Apart from their contribution to this new insight, Figures 3b and 3c again confirm that repeat burglary is relatively more important in Newville than Oldville. Burgled dwellings in Oldville that experience no further burglary for 72 weeks, drop back to background levels of risk for the area as a whole. Furthermore, the repeat burglary hazard rates in Oldville never exceed the background rate by an excessive amount.

In the course of undertaking this analysis, parametric Weibull survival models were fitted to the data for Oldville and Newville. The Weibull model provided a good fit for the Oldville data, with its slowly changing *hazard* rate, but was less successful for the Newville data, with its sharp hazard rate spike in the first 28 days of exposure. The elevation of the Weibull curve at the early data points was matched by a depression of the curve at the end of the exposure period, leading to an underestimation of the hazard rate in the longer term. Weibull modeling was used successfully by Spelman (1995).

Figure 3a: Parkville Repeat Burglary Hazard Rates and 95% Confidence Intervals in 12-week Follow-up Periods

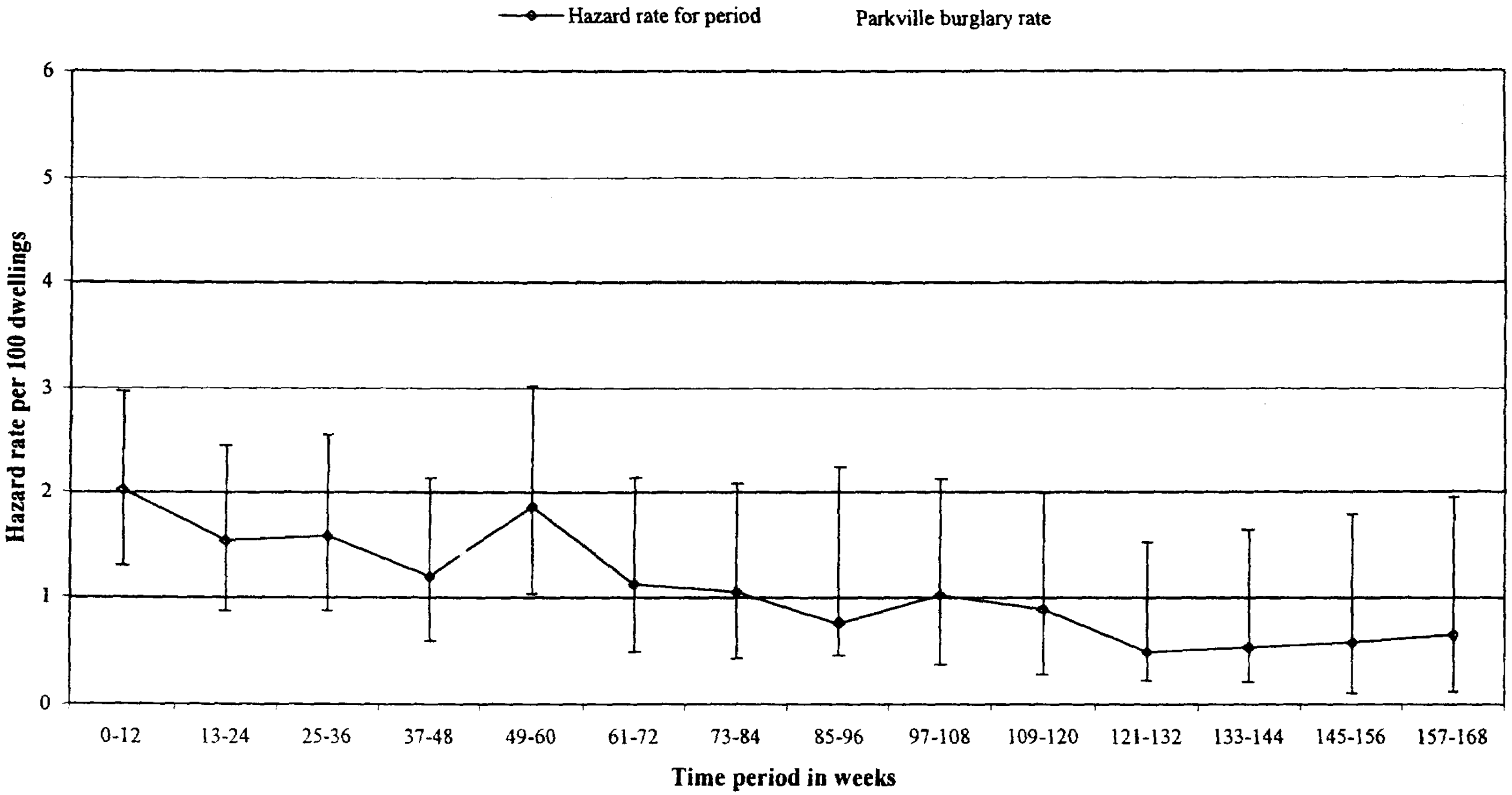


Figure 3b: Newville Repeat Burglary Hazard Rates and 95% Confidence Intervals in 12-week Follow-up Periods

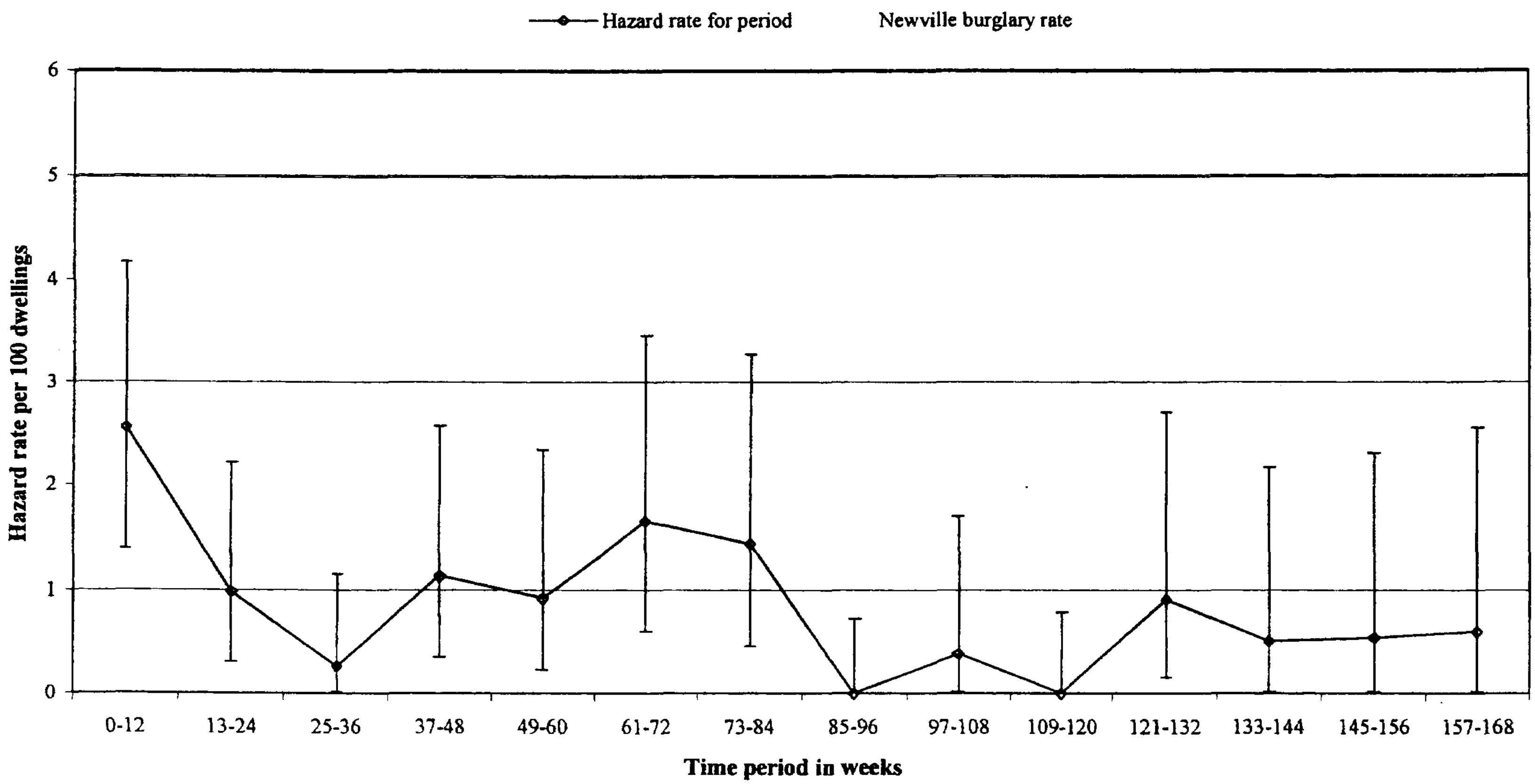
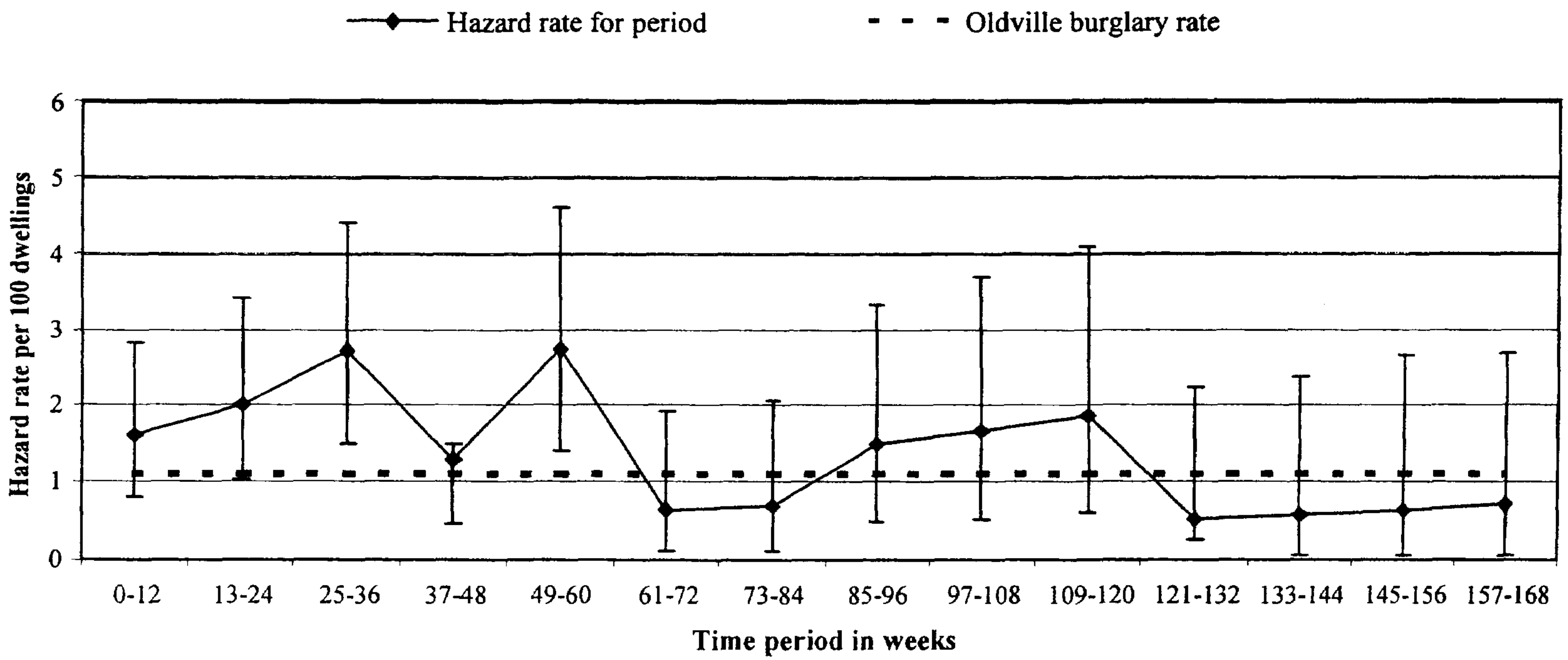


Figure 3c: Oldville Repeat Burglary Hazard Rates and 95% Confidence Intervals in 12-week Follow-up Periods



DISCUSSION

This study in Parkville indicates that quite different patterns of burglary and repeat burglary coexist within a small Perth suburb. It is clear that large and stable burglary rate differences exist within CDs whose centres may be only 200 or 300 meters apart. The reasons for this situation are, no doubt, tied to differences in opportunities for burglary, ease of access to dwellings, expected payoffs from burglary and the routine activities of residents and visitors to the suburb. The uncovering of such small-scale variation in burglary patterns in a Perth suburb mirrors the findings of Bottoms and others (1987) in Sheffield. It may be that burglaries in other areas in Perth are more evenly distributed, however, few burglary studies are designed to investigate burglary at the small scale, and the results from Parkville indicate the potential importance of testing for small-area differences within any larger area.

The Life Table survival methodology proved useful for this repeat burglary analysis. Survival methods are designed to handle exactly those forms of data that arise in repeat victimisation studies, and it seems natural that repeat burglary researchers should adopt various forms of survival analysis. In the absence of any strong hypotheses about the time distribution of repeat victimisation, non-parametric procedures such as the Life Table are safe methods to begin with. An important point concerns the quality of repeat victimisation data in comparison with repeat offending data: the victimisation data are bound to be more reliable. This is because they result from only one filtering process — the decision to report a crime to police — whereas recidivism data result from two processes of filtering: the decision to report to police and then the attempt to find an offender.

Knowledge of these differential burglary patterns is illuminating for an understanding of the potential impact of crime prevention initiatives based on a repeat victimisation strategy. In Oldville, burglary rates are high and, as expected, repeat burglary risk is high. However, there is no evidence that repeat burglaries are particularly weighted towards the short-term, and there is no necessary offender link between successive burglaries. Oldville residents experience the majority of burglaries in Parkville, and crime prevention initiatives in the area need to take long-term risk factors into account. Another point of interest is that Oldville burglary victims have higher risks of an ensuing burglary than other Oldville residents. The reasons for this are unclear, but may be related to some unexamined risk factors[18] at the level of the individual householder. Area factors should not be expected to capture all of the variation in burglary risk across households. Regardless of the level at which these risk factors operate, the time-course of repeat burglaries suggests that risk heterogeneity offers a more plausible explanation of repeat burglaries in Oldville than does event dependency.

In Newville, on the other hand, overall risks of burglary are low, and repeat burglary rates are below Oldville's. Nevertheless, the time-course of repeat burglary in Newville indicates that the first month after a burglary represents a period of elevated risk. The time gap suggests that an event dependency explanation will be most satisfactory in Newville. Mechanisms whereby the same offender returns or where one offender passes on information to another may apply to Newville. After the first month, the risks of burglary drop back to lower levels characteristic of Newville. It appears, therefore, that burglary victims in Newville could profitably focus on crime prevention measures that address short-term risks.

One point should be noted about the Newville data. The very high risk experienced among burgled dwellings is subject to qualification. It is certain that all of these rapid repeat burglaries were repeats in the sense that they occurred at the same street address. However, it is not certain that they all occurred at precisely the same dwelling unit at these addresses. The method adopted to cope with addresses with ambiguous unit numbers[19] could lead to either over-estimation or underestimation of repeat burglaries. But its tendency would be to overestimate repeats given the number of units at these addresses. The issue may not be important if we are inclined to adopt a broader notion of repeat burglary. It is possible, however, that in a strict sense repeat burglaries may be overestimated in areas where many dwelling units cluster at individual addresses.

Published research from Canada and the U.K. has focused on the elevated risks associated with repeat burglary — a risk that apparently arises from the burglary event itself. A further concentration of risk appears to be present in the short term, usually taken to be the first few months after an initial burglary. The results reported in this paper reproduce these overseas findings in onf small geographic area but not in another. Furthermore, the results from this Perth study point to the greater relative importance of repeat burglary in a low-burglary area, another finding in contrast to the published literature, which tends to emphasise the increasing importance of repeat burglary as burglary rates rise. In one sense, the results in Parkville are confirmatory — repeat burglary rates *are* higher in the area with higher overall rates of burglary. However, the ratios of repeat burglary rates to overall burglary rates are not very large (2.7 in Newville and 1.5 in Oldville), and the ratio is higher in the low-burglary area.

A study by Osborne et al. (1996) is consistent with the kind of results obtained here. These researchers used a statistical methodology that controlled for the factors associated with initial victimisation risk when modeling the risk of repeat victimisation. They found, as we did with the Parkville burglaries, protection against subsequent victimisation is reduced in low-risk households, and that differences in overall or initial risk shrank for repeat victimisation. The Osborne study used a combination of individual and contextual variables to predict risk, whereas simple small-area indicators were used in the Perth study. The findings of both studies are consistent with the interpretation that, relative to the expected risk, repeat burglary is more important in low- than in high-burglary areas.

This first analysis of repeat burglaries in a Perth suburb has not discovered the same degree of burglary risk concentration evident in studies elsewhere. However, despite this finding, it may still be the case that a repeat burglary focus could prevent many crimes. It was clear from the arguments of Pease (1993) and others that there are other aspects of a repeat burglary prevention strategy that could apply to burglaries in general. For example, victims may be more prepared to implement prevention measures than non-victims; the "drip feeding* of burglary prevention based on burglary victimisation may lead to the effective use of and a concrete focus for police prevention activities. Furthermore, a close analysis of the Parkville burglaries provides evidence of forms of burglary clustering other than repeat burglary at the same address. These may be amenable to prevention through some of the same initiatives that have been implemented to reduce repeat burglary. In Parkville, there were so many burglaries concentrated into one particular month of the 60 months studied[20] that the probability of this happening by chance alone was approximately one in a billion. Clearly, an offender or group of offenders was active in the suburb over this period. An examination of these burglaries indicated two repeat burglaries, but also several "near-repeats" — burglaries of dwellings located close to an initial victim that were targeted later in the month. If some form of "cocoon watch" (Forrester et al., 1988) had been implemented soon after the initial burglaries, then several of the later burglaries in that month could have been prevented, rather than simply the two that fitted the strict definition of repeat burglary. Evaluations of repeat burglary prevention strategies reveal a broader impact than could be expected on the basis of preventing repeat burglaries alone. Future research should attempt to identify why these strategies appear to generate a "diffusion of benefits" (Clarke, 1997) into first-time burglaries as well.

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NOTES

1. The boundaries of the area in question are well marked by major roads and a railway line; however, they enclose elements of two official localities. Nevertheless, for convenience the area will be referred to as a suburb.

2. Perth has a population of 1.3 million people.

3. Australia was ranked highest for household burglary (4.4% annual prevalence), followed by the U.S. (3.8%) and Canada (3.0%).

4. CD is the smallest geographic unit for the collection and publication of data for the Australian Census. One CD includes approximately 200 dwellings.

5. These large differences in victimisation levels revealed by police data were confirmed by the results of local crime surveys in the two areas.

6. For example, the 1993 National Crime and Safety Survey in Australia (Australian Bureau of Statistics, 1994), which surveys a larger fraction of the population than most national surveys, collected information on approximately 52,300 people out of a relevant population of 13.8 million — a sampling fraction of under 0.4%.

7. It is not clear from the research whether the "expected rate" refers to the group of repeat burglaries or to the city as a whole. If it applies to the group of repeat burglaries, then the repeat victimisation rate in the first month is approximately 45 times the citywide base rate (12x3.7).

8. Many other writers use the term *state dependency.*

9. Bennett does not report whether or not this was a common strategy for burglars.

10. This strategy is not one that would be accepted by all. In the field of preventive medicine, for example, Rose (1992) argues that disease prevention efforts should deal with the population as a whole, rather than with those individuals who are found to exhibit certain risk factors. However, in the field of criminology, increasing attention is being directed to risk assessment for both victims (Farrell, 1995) and offenders (Kemshall, 1995; Association of Chief Probation Officers, 1994; Feeley and Simon, 1992).

11. Support for this approach is gained if we acknowledge that the measurement of the first burglary in our data set is always arbitrary. Any included household may have experienced many prior burglaries, which are unobserved because of the limited time window through which we view our data.

12. A fictitious name.

13. Some addresses are not valid because of the vagaries of street numbering. For example, numbers 15, 17 and 19 may be followed by numbers 25, 27 and 29.

14. It must also be remembered that studies without access to a comprehensive street-address database may count these events as repeats anyway, absent any knowledge that the address contains multiple dwelling units.

15. Oldville consists of the two CDs labeled in Table 1 as Old town and Gateway, while Newville consists of the remaining four CDs.

16. Prevalence is defined here as the percentage of dwellings from the appropriate base that experience one or more burglaries, while incidence is defined as the number of burglaries per 100 dwellings in the base. Each measure is converted to an annual rate.

17. The "over 1,820 days" message means that the median time for Newville did not fall within the available coverage of the Parkville data.

18. The occupancy rate of the dwelling and its accessibility are two such factors that may be important.

19. Recall that an address with a specific street number but an ambiguous unit number was coded to a fictitious "unit zero" at that street number.

20. A total of 25 burglaries in that month compared with an average of 6.5 per month between 1991 and 1995.