



Home Office

BUILDING A SAFE, JUST
AND TOLERANT SOCIETY

Pushing back the boundaries: new techniques for assessing the impact of burglary schemes

Kate Bowers

Shane Johnson

Alex Hirschfield

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Reducing Burglary Initiative Evaluation

The Reducing Burglary Initiative

In 1998 the Home Office announced the Crime Reduction Programme. The programme was intended to develop and implement an integrated approach to reducing crime and making communities safer. The Reducing Burglary Initiative (RBI), launched in 1999, was one of the first parts of this programme to commence.

The aims of the RBI are to:

I reduce burglary nationally by targeting areas with the worst domestic burglary problems;

- evaluate the cost effectiveness of the different approaches and;
- find out what works best where.

Two hundred and forty seven burglary reduction projects have been funded, covering over 2.1million households that suffered around 110,000 burglaries a year. Three distraction burglary projects have also been funded.

The Evaluation

Three consortia of universities have intensively evaluated the first round of 63 RBI projects. A further five projects from subsequent rounds of the RBI (rounds two and three) are also being evaluated.

This report is part of a series of studies examining burglary reduction practice being published during 2003. Also to be published are a summary and full report on the overall impact and cost-effectiveness of Round 1 of the RBI. Other themes to be covered in this series are:

- the delivery of burglary reduction projects;
- police detection strategies;
- publicity and awareness of burglary reduction schemes; and
- the use of alley-gates as a means to reduce burglary.

Published reports

Early lessons from the RBI have already been published in the following reports, which are available from www.homeoffice.gov.uk/rds/pubsintro1.html

Tilley N, Pease K, Hough M and Brown R (1999) 'Burglary Prevention: Early Lessons from the Crime Reduction Programme' Crime Reduction Research Series Paper 1, London: Home Office

Curtin L, Tilley N, Owen M and Pease K (2001) 'Developing Crime Reduction Plans: Some Examples from the Reducing Burglary Initiative' Crime Reduction Research Series Paper 7, London: Home Office

Hedderman C and Williams C (2001) 'Making Partnership Work: Emerging Findings from the Reducing Burglary Initiative' Briefing Note 1/01, London: Home Office

Johnson S and Loxley C (2001) 'Installing Alley-gates: Practical Lessons from Burglary Prevention Projects' Briefing Note 2/01, London: Home Office

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The authors

Kate Bowers and Shane Johnson are Research Fellows at the Environmental Criminology Research Unit (ECRU) at the Department of Civic Design, University of Liverpool. Their main role in the evaluation has been in the creation and application of quantitative methods to measure changes in patterns of victimisation, some of which are described here. Alex Hirschfield is a Reader in Planning, also based at ECRU in the University of Liverpool. He is the Principal co-ordinator of the Northern Consortium, formed to undertake the evaluation of 21 burglary reduction schemes in the north of England.

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Main findings

This report describes the main findings of a detailed evaluation of a burglary reduction project located in Liverpool in the North of England. The scheme consisted of four interventions: alley-gating, target hardening of property, property marking and an offender rehabilitation intervention. New analytical techniques, discussed in detail in this report, were developed in order to answer the key evaluation questions. The results may be summarised as follows:

- Identifying the precise geographical areas in which crime prevention interventions are implemented is important in assessing the effectiveness of schemes. For the Liverpool scheme, the official boundary of the target area was defined as two complete police beats, although the interventions were focused almost exclusively within three sub-areas. Analyses revealed that burglary reduction was dramatic in the sub-areas of intense implementation *within* the official boundary of the scheme.
- Statistical analysis, comparing the police beats that made up the scheme area to other police beats in Merseyside, showed that the reduction in burglary was statistically significant.
- Repeat burglary, as well as single incidents of burglary, significantly reduced in the scheme area.
- Analyses of crime rates in the areas that surrounded the scheme suggested that there was some evidence of geographical displacement. However, in a buffer zone that was within very close vicinity of the scheme, a diffusion of benefit (i.e. a reduction in burglary) was also evident.
- There was some evidence that following the implementation of the scheme offenders may have switched to committing other types of crime within the scheme area. In particular, theft from car significantly increased in the area. There was no significant switch to theft from a person, taking a vehicle without the owners consent or theft of car.

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- In the sub-areas where crime prevention activity was concentrated, there was evidence of a diffusion of benefit to untreated households. In other words, burglary reduced in both those properties that had been treated and those that had not.
 - In order to get the most accurate assessment of the effectiveness of crime prevention strategies aimed at individual properties, it is necessary to examine the pattern of victimisation of these properties over time. Doing this for the Liverpool scheme revealed that 13 burglaries were prevented in a one-year period across 363 properties that had been target hardened. Moreover, the risk to these properties was almost halved following target-hardening. This exercise was done for each intervention type.
 - Assessment should be made of the degree to which other initiatives in a scheme area are likely to cause burglary reduction. In the Liverpool scheme, it was concluded that such initiatives were unlikely to have contributed to the reduction found.

The implications of these results for crime prevention are discussed in the report.

Executive summary

This report is a result of evaluation research undertaken in the north of England, that was commissioned by the Home Office to assess the impact of burglary projects funded under the first round of the Reducing Burglary Initiative (RBI). This paper, which focuses on one burglary scheme undertaken in Liverpool, demonstrates the power of using disaggregate, or individual level, burglary data in assessing the impacts and outcomes of such schemes, and illustrates that very different conclusions may be drawn when such analyses are not conducted.

The first three procedures described examine methods of measuring the impact of crime reduction schemes on levels of burglary (and other crimes) within the operational boundaries of the initiative. These concern:

Measuring changes in the burglary rate

This compares changes in the burglary rate within the boundary of the scheme with a series of comparison areas. The comparison areas included one police beat, matched on social and economic characteristics with the scheme's operational area, the wider police Basic Command Unit (BCU) and the wider Police Force Area (PFA). Importantly, changes in the burglary rate for the entire scheme area (which is the only analysis possible with aggregate level data) are compared with changes in smaller sub-areas of the scheme into which treatment was concentrated. The analysis revealed that the scheme had a substantial impact on the burglary rate for the sub-areas in which crime reduction activity was almost exclusively concentrated, but that the change in the burglary rate was relatively modest for the entire scheme area. This finding demonstrates that sub-scheme analysis is essential in measuring the real impact of measures taken, particularly when initiatives are geographically concentrated.

Statistical procedures for assessing impact

In order to assign statistical significance to changes in the burglary rate in the scheme area, a method was developed that compared these changes with those experienced in other police beats throughout the county of Merseyside. Specifically, z-tests were undertaken to

see whether the reduction in burglary in the scheme area was significantly different from that seen in police beats in general. Results demonstrated that changes in the burglary rate for the scheme area, and in particular for the sub-areas, were statistically significant.

Examining the distribution of repeat victimisation

This section highlights the importance of examining the concentration as well as the incidence and/or prevalence of burglary. There was evidence that levels of repeat burglary, as well as burglary per se, had decreased disproportionately in the scheme area when compared with the comparison areas. Interestingly, decreases in the repeat rate were detected in areas that had not experienced a decrease in burglary per se. This illustrates that to fully understand the impact of crime reduction activity, it is necessary to consider repeat victimisation in addition to simple burglary rates.

The paper proceeds to consider the possibility of crime displacement; that is, whether the measures taken as part of the burglary reduction scheme caused local burglary offenders to change their offending behaviour by targeting other properties, other areas or other types of crime. Therefore, three different types of displacement are considered here:

Geographical displacement

This describes a method for assessing the extent to which offenders move to other areas to commit burglary as a result of the action being taken. Pre and post-intervention burglary rates were examined in the target area, a buffer zone that surrounded the scheme, and the wider police force area. The theoretical rationale for the analysis was three-fold:

1. For displacement to occur there should be a reduction in the burglary rate for the target area indicating that offenders were avoiding this area (to some extent), thereby increasing the possibility that they would target alternative areas.
2. That coincident with this change the crime rate in the buffer zone should increase.
3. Finally, that the changes observed in both the target and buffer zone areas should exceed those observed in the wider police force area, thereby demonstrating that they did not simply reflect a more general trend.

Detailed analysis considered change in the crime rates for a series of five smaller displacement buffer zones contained within the general buffer area. The method of calculation (which calculates a 'weighted displacement quotient' WDO) therefore compares changes in the burglary rates for these five different (but nested) areas over time. Briefly, a single statistic is produced which describes the extent to which displacement (or, of course, diffusion of benefit) is likely to have occurred. Positive WDO values indicate diffusion of benefit to the buffer zone and negative WDO values indicate geographical displacement of crime. Considering the WDO values, a figure of +1 indicates a diffusion of benefit where the burglary reduction in the buffer zone is equal to that in the project area. A figure of -1 indicates a displacement where the burglary reduction is entirely offset by increases in the buffer zone. A WDO of zero represents a scenario where there was apparently no change in the buffer zone, or where this change could not be attributed to changes in the SDP.

Results of the analysis showed some evidence of geographical displacement as a result of the Liverpool scheme. Interestingly, there was evidence of a diffusion of benefit in the immediate vicinity of the scheme. In contrast, there was substantial evidence of displacement at a distance of approximately 400 metres or more from the operational boundary of the scheme. In addition, the pattern of results suggested that there was evidence of a distance-decay effect, with the extent of geographic displacement dissipating across greater distances.

Crime type switch

This assesses the extent to which the action taken causes offenders operating within the scheme area to switch to perpetrating offences of other types of crime. The analysis was limited to other types of property crime, namely theft from a person, taking of a vehicle without the owner's consent, theft of car and theft from car. It was found that very different trends were observed in these crime types. Crucially, although theft of car did not appear to be affected in the area, theft from car increased very significantly when compared with changes observed in the comparison areas. Further analysis revealed that this pattern of results was statistically significant. It is hypothesised that the reason for this switch is that the skills required for committing theft from car and burglary are very similar and they are both likely to yield goods that can be sold on for financial gain.

Target switch

A third type of displacement that may result from crime reduction activity is that of target switch. It is possible that where certain houses have been treated on a street (e.g. by target hardening measures), offenders will simply target other properties that have not received treatment. This issue was investigated by identifying all treated and untreated properties in the sub-areas of the scheme in which crime reduction activity was concentrated. Changes in burglary rates were calculated for both groups of properties. Interestingly, relative to the drop in burglary in the treated properties, burglary rates in the non-treated properties fell almost as much. This effect was not observed in any of the comparison areas, nor, indeed, for the rest of the scheme areas (those outside the three sub-areas). This shows a very local diffusion of benefit effect, whereby houses situated near to treated properties also appear to have been avoided by offenders after the measures were installed.

The procedures discussed above outline methods of assessing impacts of burglary schemes as a whole. However, it is important to remember that it is very unusual for schemes to concentrate solely on one intervention. Far more commonly, schemes involve undertaking a number of different interventions to combat a burglary problem. In the case of Liverpool, for example, four different interventions were involved: target-hardening, property marking (Smartwater), alley-gating and an offender behaviour scheme. In order to start to understand what it is that makes a scheme successful, it is important to try to isolate the impact of the individual interventions undertaken. Therefore methods were developed which:

- **Can be used to assess the impact of individual interventions**

This technique uses information on the actual individual properties that were treated as part of an intervention. For illustrative purposes, this section focuses on target-hardening. It was found that by examining levels of burglary in these properties by simply taking the overall start date of the scheme to define before and after periods, the target hardening intervention appeared to be very ineffective. However, further analyses that used information concerned with the actual date of target hardening for each property revealed a very different picture. The method described also corrects for differences in opportunity due to the fact that the before and after target-hardening periods examined will vary depending on the exact date of target hardening. These 'opportunity-dependent rates' are then used to calculate an outcome in terms of the number of burglaries prevented by the intervention, by comparing the after target hardening rate to an expected rate produced using the before period. The

method also takes into account general changes in the burglary rate at the county level over time. Results indicated that the target hardening intervention, which involved 363 properties, prevented 13 burglaries in a one-year period.

- **Apply this method to each intervention type**

This opportunity-dependent rate method was used to calculate outcomes for each of the three geographically targeted interventions in the Liverpool scheme area (that is, target hardening, alleygating and property marking). One complication is that individual properties could receive up to three of these treatments. In other words, whilst some properties only received target hardening, others could have received target hardening and property marking, target hardening and alleygating, or, indeed, all three measures. Outcomes were therefore calculated for each of the possible combinations of interventions. Results indicated that target hardening, either on its own or in combination with other interventions, appeared to be particularly effective.

A final section addresses the issue of other crime reduction efforts, which could potentially have a confounding effect on the outcome analysis described in the report. Other crime reduction and regeneration activities were operating in the area within the timescale of the Liverpool SDP. However, these other schemes were implemented across wide areas of the city of Liverpool. For this reason, it can be assumed that the BCU, the comparison area and the buffer zone of the SDP would all have been affected by these other initiatives. This means that to a certain degree the influence of other initiatives was controlled for. The report concludes that 'other interventions' were unlikely to have contributed to the change observed in the scheme area.

As far as we are aware, the majority of published crime reduction evaluations have, in the past, utilised recorded crime (and other) data that is aggregated to particular geographical area units such as police beats or local authority wards. Whilst the use of such data enables evaluators to determine the effects of a particular scheme at the general area level, it clearly precludes the computation of more sophisticated analyses. Such analyses should, critically, allow specific a priori (and, of course, post hoc) hypotheses to be tested that may potentially explain why a particular scheme was or was not successful, or whether it was successful in some respects but not others. For instance, for a target-hardening scheme, whilst the crime rate for the general area in which the scheme operates may be unaffected, target-hardened households may experience significantly lower levels of victimisation than would have been expected had the scheme not existed. Alternatively, although the burglary crime rate may remain unchanged, levels of repeat victimisation may be dramatically reduced. In addition, and importantly, the use of aggregate level data also limits the investigation of whether there were any unexpected side effects, or spin-offs of the scheme, such as the geographical displacement of crime. To do this type of analysis, one would require disaggregate level data, which provides data concerning individual incidents of crime and includes information on the address, geographical location (e.g. an easting and northing grid reference) and date of the offence (for a further discussion of this issue, see Johnson et al, 2001). Studies that have used disaggregate level crime data (e.g. Anderson et al, 1995; Bennett and Durie, 1999), whilst being insightful have been limited to analyses of rates of victimisation and repeat victimisation at the area level only.

In 1999 the Home Office launched the RBI, a multi million pound initiative aimed specifically at reducing domestic burglary. A total of 63 projects were commissioned in the first round which varied considerably in terms of the interventions they employed, although most had a strong situational crime reduction focus. Of these, 21 were commissioned in the north, Midlands and south of England respectively (for more details, see Tilley et al, 1999). In addition to funding the projects themselves, the Home Office commissioned three evaluation consortia to evaluate the schemes operating in the different regions. The consortium commissioned to evaluate the schemes operating in the North of England comprises research groups based at three different universities, these being the Environmental Criminology Research Unit (ECRU) at the University of Liverpool, the Applied Criminology Group (ACG) at the University of Huddersfield, and the Centre of Criminology and Criminal Justice at the University of Hull.

Part of the evaluation design adopted by the Northern consortium was to conduct in-depth case studies for each of the schemes using disaggregate level data. However, for numerous reasons, one of the most influential being police data protection procedures, the Northern consortium was unable to obtain such data for three of the five police force areas that cover the northern region. In addition, data for one of the police forces was obtained at a very late stage in the evaluation. Taken together, these problems limited the number of case studies that could be conducted. However, links between the evaluators and the Merseyside Police Force led to the consortium having access to this information for Merseyside from the beginning of the evaluation. Therefore, the Liverpool Strategic Development Project (SDP) has been selected as a case study to demonstrate the sophistication of the analysis that is possible where good information is available and to illustrate some of the new techniques developed for the evaluation.

The current report will first discuss the Liverpool scheme and the interventions employed, and then present analyses concerned with the outcome of the scheme. Particular emphasis will be placed upon the new techniques developed to measure the statistical significance of any changes in the crime rate for the target area, the effectiveness of target-hardening and the extent to which geographical, crime-type and target-switch displacement were evident. Other sections will consider changes in the rate of repeat victimisation, and a novel approach to mapping the change in crime rates.

The Liverpool case study

The Liverpool SDP is situated in the county of Merseyside. Figure 1.1 is a detailed map of the SDP target area, which shows the operational boundary of the scheme superimposed on an orthophotograph of the area. It is evident that the target area is composed of some open land and a number of streets of terraced housing. The Liverpool SDP scheme employed four different interventions, as follows.

The target-hardening scheme involved the surveying of, and where appropriate, the installation of physical security measures which included new mortice locks, door chains and window locks. Specifically, residents were offered target-hardening if they fitted the criteria adopted for the scheme, i.e. that they had already been victims of crime or that they fitted the typical profile of a vulnerable resident, which included elderly residents, students and those on a low income. Eligible residents were identified in one of two ways. First, residents who were victims of burglary were contacted and subsequently visited by the target-hardening surveyor (a specific targeting approach). Second, residents were also

visited as part of a more general strategy, whereby the surveyor visited all households contained within the target area. This two-level approach ensured that burglary victims were assisted as close to the incidents' occurrence as possible.

Figure 1.1: *Liverpool Strategic Development Project Area (sub-areas shaded in white)*



The Smartwater intervention involved the marking of residents' personal property to increase the likelihood of stolen property being recovered, and to discourage offenders from burgling protected properties. Smartwater is essentially a chemical solution, undetectable to the human eye unless examined under ultra-violet light, that is applied to items of personal property. The solution itself represents a chemical marker, for which the chemical sequence has an almost limitless number of combinations. With the right equipment it is possible to identify a particular Smartwater code or sequence. The approach adopted by the Liverpool team was to property mark personal property for households located on different streets using different versions of the solution, meaning that any recovered property could be identified as belonging to an individual living on a specific street. Additional information including a description of each item of property was recorded on a computer database, meaning that for any item of recovered (marked) property the actual owner should be identifiable. To ensure that any recovered items of personal property could be identified,

ultra-violet lights were installed in the police stations that service the target area and police officers received training regarding the intervention. For each household, residents had up to ten items of personal property marked using smartwater. In addition, as a deterrent to offenders, all households that had been property marked in this way were given a sticker to put in their window, to indicate that they were part of the scheme. All residents who lived in the specific target area were offered this intervention.

The third intervention was an alley-gating scheme that involved the installation of lockable hard-wearing gates to both ends of the alleyways at the rear of the properties, with the aim of restricting access to potential offenders. Due to legal requirements, prior to the installation of the gates it was necessary to obtain approval from the residents affected by the scheme.¹ Thus, teams of surveyors, funded through levered-in resources, visited properties to seek residents approval and to explain the scheme to them. As experienced by other schemes (see Johnson and Loxley, 2001), the legal process of applying for closure orders for each of the alleyways impeded the progress of this scheme. Thus, although all of the surveys were completed by May 2000, only ten of the 69 gates were installed before 1 April 2001. Thus, only these ten gates will be considered in the research described below.

The final scheme was an offender-based scheme named the 'Wavertree Dordrecht project'. This involved the intensive supervision of offenders with the aim of changing their attitudes towards offending and their offending behaviour. This scheme, which is still ongoing, is supported both by Merseyside police and the probation service, who each provided one member of staff to work on the project on a day to day basis. Home Office funding was used to match fund (50 per cent) the salary for the probation officer for a period of one year. The scheme is aimed at offenders either on licence, or at the pre-trial stage of sentencing who had committed burglaries within the target area. Offenders who met the

1 Where a back alley provides no right of way to any person other than the immediate residents - i.e. a private right of way, many local authorities run alley-gating schemes which allow such alleys to be closed off with the consent of all the residents. The Guidance for those involved in alley-gating is on the Home Office crime reduction website at www.crimereduction.gov.uk/gating.htm. Further guidance can be found in the Home office Briefing Note 2/01 "Installing Alley-gates: Practical Lessons from Burglary Prevention Projects" which may be viewed on the Home Office website at www.homeoffice.gov.uk/rds/prgbriefpubs1.html

Where a back alley carries a public right of passage, a legal closure/diversion is necessary. The new provisions in Sections 118B and 119B Highways Act 1980 allow an authority to apply to have an area that is a crime 'hot spot' designated, allowing rights of way within that area to be closed or diverted for crime reduction purposes. Local highway authorities will usually take the lead, working with crime and disorder reduction partnerships, police authorities, local residents and user groups to formulate a submission to the Secretary of State seeking the inclusion of an area, or areas, in a designation order. In county areas, the district authority or the local crime and disorder reduction partnership may be able to make a submission if the county council is unwilling to do so. The authority will need to show (a) that the area has a right of way that can be shown to facilitate high levels of persistent crime and (b) that previous attempts to reduce crime in the area have been tried and found to be ineffective. Guidance is available online at: www.defra.gov.uk/wildlife/countryside/cl/publicrow.htm

criteria for the scheme were largely identified by colleagues in the probation service who had been informed of the scheme. Once identified, offenders were approached by the staff and invited to participate. During the period 1 January 2000–31 March 2001 a total of six offenders had been recruited and had participated in the scheme.

These interventions do not all operate in the entire target area, and, in particular, the target-hardening, property marking and alley-gating initiatives were almost exclusively concentrated within the three sub-areas shaded white in Figure 1.1. Since sub-areas were used for three of the four interventions there is the possibility that the initiatives could have caused some displacement of burglary within the target area. Moreover, it is also possible that any reductions in burglary rates would only have been observed in these areas.

The offender scheme is distinct from the other three interventions since it is not geographically targeted in sub-areas of the target area. Furthermore, its approach to burglary reduction is rather more long-term, as it takes an offender –based, rather than a situational prevention-based, perspective. For these reasons, although the offender intervention is accounted for in analyses that consider the overall effect of the scheme, its individual impact on burglary in the scheme area is not assessed in the analysis that follows.

Contextual information

More specific contextual data for the SDP area is available from the 1991 Population Census, and the left hand column of Table 1.1 summaries some of the socio-demographic characteristics of the SDP. The Table shows that the area is made up of 3317 households, of which the majority of houses are terraced properties, making up 79.4 per cent of the total households in the area. There is also a substantial percentage of flats and bedsits in the area (14.5 per cent). Interestingly, the SDP area is not as deprived as some of the other SDPs in the Northern Consortium area; there is a high percentage of households that are owner occupied (70.4 per cent) and a lower than average number of households without a car (44.9 per cent compared to a consortium average of 55 per cent).²

Part of the evaluation methodology adopted involves defining and studying crime trends in a series of comparison areas for each of the 21 projects. These areas include the remainder of the police force area (PFA–SDP), the remainder of the police basic command unit (BCU–SDP) in which the SDP is located and a further area with a socio-demographic profile as similar to

² It should be noted that because all these figures are taken from the 1991 census, it is likely that some of this information is out-of-date. However, since the SDP area is mainly composed of well-established older housing, the housing stock of the area is unlikely to have changed dramatically over the last ten years. Although the SDP area did not conform to census geography, a procedure that makes a correction for this boundary problem was used that has been described in full elsewhere (Hirschfield and Bowers, 1997).

the SDP as possible. This last area, which will subsequently be referred to as the 'comparison area', was selected through an iterative search process using a geographical information system (GIS). The criteria for selecting the comparison area were as follows:

- that the area conformed to police beat geography;
- that it was in the same local authority district as the target area;
- that it was as similar as possible to the target area in terms of its socio-economic makeup;
- that it was not contiguous with the SDP (to ensure that changes in this area could not simply be attributed to geographical displacement from the SDP).

The right hand column of Table 1.1 shows that the SDP and the comparison area are similar in terms of census variables. As is the case with the SDP area itself, the comparison area is primarily composed of terraced houses and has a high percentage of households that are owner-occupied. In addition, it has very similar levels of households without a car to the target area.

This section has provided contextual information on the SDP and comparison areas. The rest of this paper will examine changes in the burglary rate and distribution of crime since the SDP has been operational. The first section looks at these changes and at the issue of repeat victimisation, whilst sections 2 to 4 consider three different types of displacement. These are *geographic displacement*, which is said to have occurred when offenders commit crimes that they would have committed in the target area in a buffer zone that surrounds the target area; *crime-switch*, whereby offenders commit other types of (replacement) crime(s) instead of burglary; and *target-switch*, where offenders still commit crimes within the target area(s) but select individual properties that have not been subject to the crime reduction strategy. Section 5 focuses on the individual target hardening of properties in the area and its effect on burglary rates. Section 6 expands on this by assessing the impact of other interventions implemented by the scheme. Finally section 7 considers the potential effect of other crime reduction initiatives in the SDP area on changes in the level of burglary within the scheme area.

Table 1.1 *Socio-demographic profile of the scheme and comparison areas*

	Scheme area	Comparison area
Households	3,317	2,658
Residents	7,889	6,670
Detached houses (%)	0.5	4.0
Semis (%)	3.3	15.4
Terraced (%)	79.4	66.4
Flats and bedsits (%)	14.5	13.4
Households owner occupied (%)	70.4	74.0
Council-rented (%)	2.9	3.7
Furnished rented (%)	8.2	5.3
Unfurnished rented (%)	10.5	7.9
Other (%)	8.0	9.0
Persons economically inactive (%)	38.7	38.1
Households without a car (%)	44.9	45.7
Persons unemployed (%)	14.7	13.9
Recent migrants (%)	10.7	13.5
Non-white residents (%)	10.8	5.5

2.

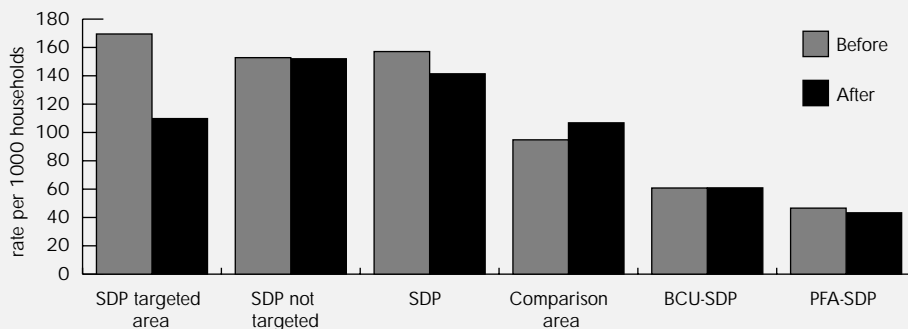
Changes in the burglary rate

Disaggregate level data concerned with burglary, covering the period 1 April 1997 to 31 March 2001, was obtained for the county of Merseyside. This data, extracted from Merseyside Police Force's Integrated Criminal Justice System (ICJS) includes the following fields of data: a unique crime reference number; crime code; the address where the burglary took place; an easting and northing grid reference accurate to within one-metre; and the date and time of the offence.

These data were used to provide historic data that covered the two-year period that preceded the start of the project (April 1999), and data that covered the two-year period 1 April 1999 to 31 March 2001 during which the SDP was active. This data was then cleaned using software generated by the researchers (Johnson et al, 1997) which amongst other things, identifies and discards duplicate records, those without grid references, those without dates, and those without sufficient information to uniquely identify the address of the offence (e.g. 21 The Road – an address without indication of the area or postcode). The clean data (the incident counts for which are shown in Appendix 2) was used to compute burglary rates for the SDP, the BCU, the Police Force Area (PFA) and other areas of interest.

A further issue that warrants discussion is the fact that whilst the target area is defined as two police beats, as noted above three of the four interventions (target hardening, smartwater and alleygating) were almost exclusively confined to three sub-areas within the SDP. For this reason, maps of the three sub areas were obtained, and the boundaries were digitised and imported into a GIS. This allowed us to calculate crime rates for the sub-area within the SDP where the three types of measure were concentrated and the remainder of the SDP that had received very little attention in terms of physical security upgrades. Figure 2.1 shows the burglary rates for six different areas for the period before and after inception of the Liverpool SDP (that is 1 April 1997–31 March 1999 and 1 April 1999–31 March 2001 respectively). These areas are the SDP as defined by its entire operational boundary, the sub-area of the SDP in which the situational crime reduction measures were focused, the remainder of the SDP (where there was little or no activity), the comparison area, the BCU in which the SDP was located, and the PFA.

Figure 2.1: Burglary rates using cleaned data before and after the SDP began



A number of clear patterns are evident in Figure 2.1. Firstly, the burglary rate in the PFA showed only a slight reduction, the crime rate in the BCU remained stable, and the rate in the comparison area actually increased somewhat. In contrast, the burglary rate in the entire SDP saw a reduction over time. However, consideration of the reductions observed for the targeted and non-targeted sub-areas of the SDP reveals that there was a differential effect in these two areas, such that whilst there was a considerable reduction in the area(s) subject to situational crime reduction, there was a much more limited effect in the non-targeted areas. For instance, the SDP sub-area had an initial rate that was 3.6 times that of the PFA, but later had a rate that was just 2.5 times the PFA rate. In contrast, relative to the PFA rate, the rates for the non-targeted areas of the SDP, the BCU and the comparison area increased. This clearly suggests that the SDP had an effect on the burglary rate, and also illustrates the fact that a much more accurate picture of what has occurred can be obtained using disaggregate data which enables analysis at the sub-scheme area. Finally, since there was evident selectivity in terms of the change in the burglary rates across the different areas, some of which had similar initial burglary rates to the target area, it is very unlikely that the change observed in the target area was simply due to regression to the mean or random factors.

Statistical significance of change in the burglary rate

Whilst the above results revealed that there was a change in the burglary rate for the SDP, they do not show whether this change was statistically significant or simply due to random fluctuation. One way of testing this is by comparing the reduction in burglary in the target area with the change observed in a series of comparison areas. Since the SDP was composed of two police beats it was decided that police beats would be the best unit of analysis. Thus, the burglary rate before and after the inception of the Liverpool scheme was

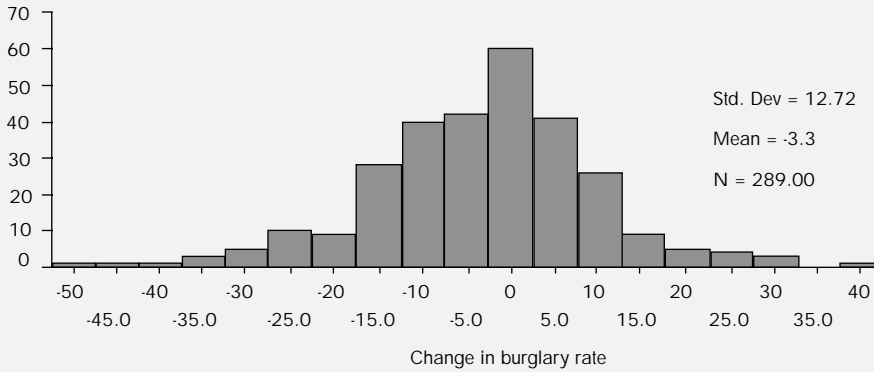
calculated for each of the police beats in the Merseyside area. To minimise the effects of outlying data, the analyses were only conducted for beats of a fairly equal size to the SDP beats, hence a subset of the beats, those with 1000 or more residential properties, were selected for the analysis. This produced a sample of 289 beats. A simple measure of change in the burglary rates in these beats was then produced, as follows:

$$\frac{\text{No burglaries in beat after 1 April 1999} - \text{No burglaries in beat before 1 April 1999}}{\text{No of residential properties in beat}} \times 1000$$

Figure 2.2 shows the distribution for these 'difference' scores for the 289 beats. It is clear that the data were fairly normally distributed, having a mean of -3.2 and a standard deviation of 12.72. Thus, on average there was a slight decrease in the crime rate over time. To see if the change in the burglary rate in the SDP was significant relative to the average change observed, z-scores, which measure how many standard deviations above or below the sample mean an observation is, were calculated for each beat. The Liverpool SDP was composed of two beats (beat codes C434 and C554) and these had z-scores of +0.37 and -1.53 respectively. The latter z-score was the 20th largest (reduction) value of the sample of 289 beats and had a p value of 0.12 (two-tailed), indicating that the decrease in the burglary rate was non-significant. Importantly, it should be noted that this analysis does not control for differences in the beats in terms of social and economic characteristics, and does not take into account the fact that many of the beats will have active crime reduction schemes operating within them which would presumably lead to a reduction in the crime rate. Therefore, the analysis is likely to be conservative in nature and is likely to underestimate (rather than overestimate) the effect of the scheme. In addition, a z-score was calculated for the targeted sub-area of the SDP. This had a value of -3.40 which is statistically significant at the 1 per cent level (two-tailed), indicating that there was a significant change in this area that exceeded the average change.

In short, relative to similar sized beats within the Merseyside region, one of the beats that made up the SDP, and the targeted area within the SDP, showed a statistically significant reduction over time.

Figure 2.2: Distribution of changes in the burglary rate for police beats



Targeted vs non-targeted areas of SDP

A further analysis considered the burglary rates in the targeted and non-targeted areas of the SDP. The purpose of this analysis was to determine whether the crime rates for these two areas followed the same trend, with the hypothesis under evaluation being that if the intervention had an effect, then whilst the two areas should follow a similar pattern before the start of the scheme, they should follow different patterns after the start of the scheme. Figure 2.1 shows that prior to the start of the scheme the rates were fairly similar, but that in the two year period that followed the start of the scheme the rate in the targeted but not the non-targeted area fell substantially. Figure 2.3 shows how the crime rates for these two areas varied over time for both the pre and post-implementation periods. It is evident that the crime rates followed a similar pattern before the start of the scheme, but they followed different trends after the inception of the scheme. To examine the way in which the crime rates co-varied over time, non-parametric Spearman's rho correlations were computed for the two time periods, using the crime rate for each of the eight quarterly time points as observations. The correlation coefficient for the before period was highly significant ($r_s(8) = .90$, $p < .01$, two-tailed) indicating that the two areas followed the same trend over time. In contrast, the correlation for the after period was non-significant ($r_s(8) = -.14$, $p = .75$, two-tailed) demonstrating that the conditions appeared to differ in these two areas for this time period, both in terms of the level of crime committed and the quarterly change in the crime rate.

Figure 2.3: Quarterly crime rates in targeted and non-targeted areas

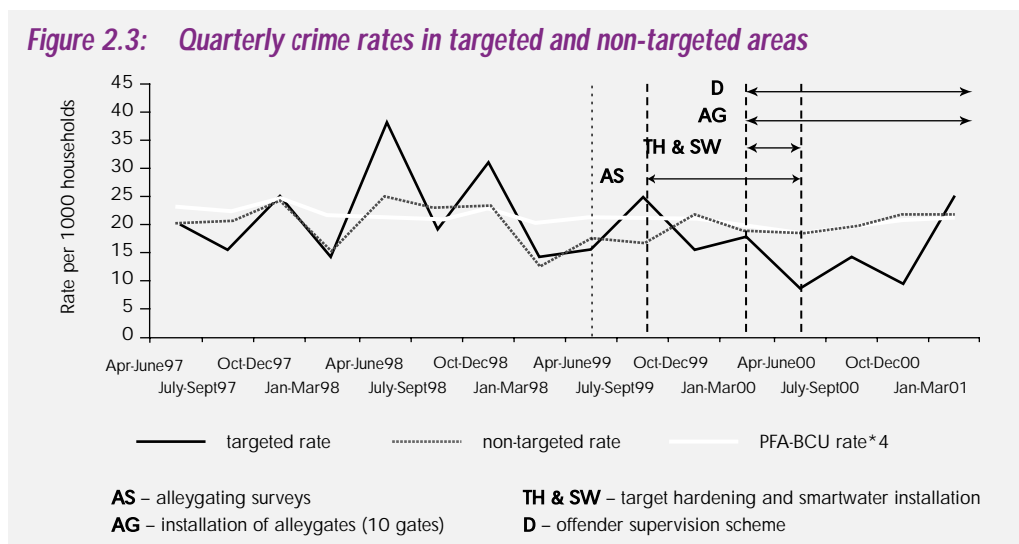


Figure 2.3 also gives an indication of the time periods during which the four interventions operated or, in the case of the target hardening and smartwater initiatives, when activity was most intensive, and shows the crime rate for the PFA (minus the BCU) which is scaled by a factor of four to ease interpretation. The figure shows a number of potential trends that may be summarised as follows. First, the change over time for the police force area and the non-targeted areas were relatively consistent for both the pre- and post-implementation time periods. For this reason, the subsequent discussion will focus on comparisons between the targeted and non-targeted areas only. Second, it is apparent that the crime rate in the targeted area fell in the quarter in which the alleygating surveys commenced (Oct–Dec 1999), whilst the crime rate in the non-targeted area actually rose quite considerably. Third, the crime rate also fell steeply in the quarter in which the target hardening and smartwater initiatives were most intensive (July–Sept 2000) and during which ten alleygates were installed. During this period, the same was true for the non-targeted area. However, it is evident that the rate of decline in the targeted area was much greater. Finally, with the exception of the first and last quarters, following the onset crime reduction activity, the crime rate in the targeted area was lower in the targeted versus the non-targeted area. This is in contrast to the trend observed for the historic period that predated the inception of the scheme, during which the crime rate in the targeted area was, in general, the same as, or slightly higher than that in the non-targeted area.

In the final quarter the burglary rate for the targeted area exceeded that for the non-targeted area. During this quarter the main implementation of crime reduction measures had finished. This is interesting as it may suggest that the effect of the scheme was not sustainable or it

could be due to lack of evidence of further physical implementation in the area leading to offenders feeling it was safe to offend in the area once more. However, further data would be required to confirm this. Taken together, the results show that there was a reduction in the burglary rate following the start of the scheme and that the reduction observed for the targeted sub-areas appeared to coincide with a crude indicator of the timing of crime reduction activity.

Methodology

To examine repeat victimisation the burglary data discussed above, and a further 12 months of historic data that covered the period 1 April 1996–31 March 1997, was analysed using software developed by the researchers (Johnson et al, 1996). This software was written in FORTRAN and works in the following way. The program developed reads in all the records concerned with domestic burglary from a recorded crime file. A dynamic array,³ in which each element pertains to a unique address, is updated as the records are read in. When a new record is read in, the array is searched to see if a crime has already occurred at that address within the previous 12 months. If it has then the corresponding record is updated to indicate that a repeat occurred.⁴ However, if this is the first incident at the address, as reflected by the absence of the address in the array, then the new record is simply added to the array. Alternatively, if the address supplied has too few characters to identify a unique address, or there is no grid reference, or the record is identified as a duplicate record by the program, the record is discarded. The resulting array includes the following information: the addresses of all households which have been burgled, the number of incidents that have occurred at each address, and the dates on which each incident occurred.

Levels of repeat victimisation

Figure 3.1 shows the levels of repeat burglary in each of the areas for the before and after time periods. It is apparent that, in general, levels of repeat victimisation actually increased over time (1 per cent in the PFA and 4 per cent in the BCU). However, in the SDP, the level of repeat victimisation actually fell by around 29 per cent. Moreover, for the SDP sub-area the level fell by around 40 per cent, meaning that for this area the level of re-victimisation fell from a figure which was initially higher than that for the PFA, to a level that was considerably lower than that for the PFA. Interestingly, whilst the crime rate did not show much of a reduction in the non-targeted areas of the SDP, the level of repeat victimisation did (25 per cent reduction). This finding clearly illustrates that it is not possible to fully

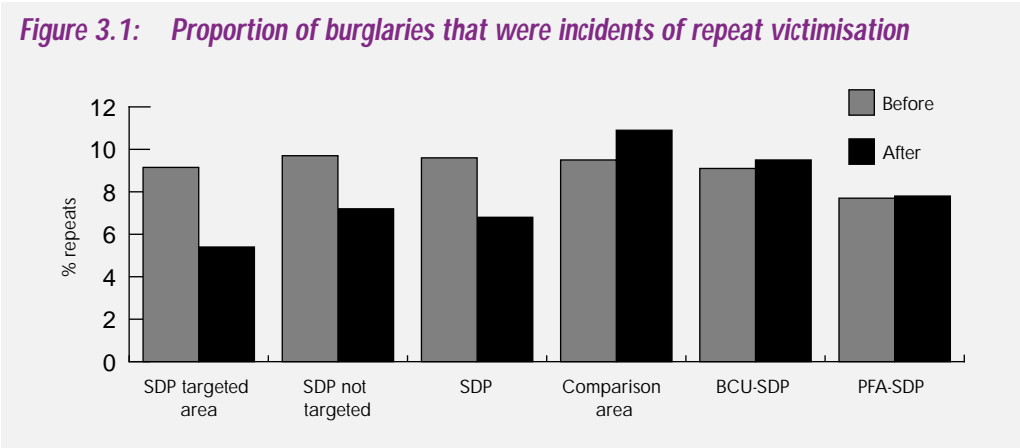
3 An array is a form of data file that is stored in a computer's memory, it is referred to here as a dynamic array to reflect the fact that the array increases in size as each new record is processed.

4 A complex address-matching algorithm was developed so that the program could determine whether two addresses were the same; this algorithm compensates, to some extent, for spelling mistakes and the inconsistency with which addresses are stored on most police databases (For a discussion of the technique see Johnson et al., 1997; and for program code used, Johnson et al., 1996)

understand the effects of crime reduction initiatives without considering repeat victimisation as well as changes in the crime rate. In this case, for the non-targeted parts of the SDP, whilst the general burglary rate remained stable, the risk to previously victimized households appeared to be reduced. Thus, it is apparent that the reduction in the risk of repeat victimisation was accompanied by a slight increase in the risk to previously non-victimised properties.⁵

However, it is also notable that the change in repeat victimisation was considerably lower than that observed within the targeted area. This indicates that the change in the victimisation pattern for the SDP sub-area was almost certainly attributable to the SDP interventions and that the change in the pattern of repeat victimisation in the non-targeted areas of the SDP was likely to be an expression of a diffusion of benefit. Hence, the effect of the SDP was not only to reduce crime in the SDP but also to reduce levels of revictimisation, which is one of the main aims of target hardening.

One possible reason for this diffusion of benefit is that offenders may have been aware that part of the selection criteria adopted by the target hardening initiative is that previously victimised properties are given priority. Furthermore, whilst they may know that a scheme is operational within a general area, it is unlikely that they will be aware of the precise boundary of the initiative. Thus, from the offender’s perspective, revictimising properties in the general area may not be as attractive an opportunity as it previously was.



⁵ Follow up analyses confirmed that the number of non-repeat incidents of crime increased in the non-targeted part of the SDP following the inception of the scheme, but reduced in the targeted area.

The sections that follow will consider three different types of displacement in some detail. To anticipate the findings, as with the results presented thus far, it will become apparent that the use of disaggregate data is essential for the analysis of crime displacement.

Geographical displacement

Geographical boundary data

The actual SDP target area for the Liverpool scheme comprised two complete police beats (C434 and C554). As shown in Figure 1.1, the boundary for the two beats was digitised and imported into the GIS. Next, to examine geographical displacement, we defined a general buffer zone that surrounded the SDP. To allow a more detailed analysis to be conducted, we defined five (rather than one) concentric buffer rings that had the same morphology as the boundary of the scheme area. The first buffer was produced so that it started at the SDP boundary and finished 400 metres from the boundary at all points. This produces a band shape that mimics the SDP boundary all the way around. A further buffer was then created that began at the boundary of the first buffer and ended a further 400 metres from this boundary, so that the outside boundary was 800 metres from the SDP boundary. Further buffers were created in the same way, until there were five rings surrounding the SDP area. Using this system of concentric buffers, it was possible to look at the change in the distribution of burglaries 0–400 ms, 400–800 ms.....1600–2000 ms away from the SDP area, to check for possible geographic displacement.

Calculating geographical displacement for each buffer

To measure the extent to which displacement or diffusion of benefit occurred, we used a new technique, the Weighted Displacement Quotient (WDQ: Bowers & Johnson, 2001), developed for the evaluation. The WDQ technique is summarized in this section, and the equation presented in Appendix 1. For an extended account along with a discussion of the research literature the interested reader is referred to Bowers and Johnson (in press). Essentially, the WDQ examines the change in the distribution of crime in the buffer zone(s) and compares this with the previous distribution of crime and with any changes in the PFA, and then relates these patterns to any changes observed in the target area. Critically, changes are measured relative to the temporal distribution of crime in the PFA, and geographical displacement is only assumed to have occurred if a reduction occurs in the target area whilst there is an increase in the buffer zone. In contrast, diffusion of benefit is presumed to have resulted if there is a decrease in both the target area and the buffer zone(s).

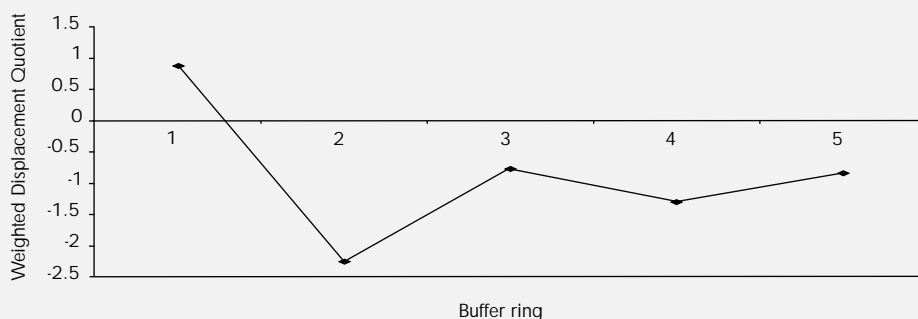
Positive WDO values indicate diffusion of benefit to the buffer zone and negative WDO values indicate geographical displacement of crime. Considering the WDO values, a figure of +1 indicates a diffusion of benefit where the burglary reduction in the buffer zone is equal to that in the project area. A figure of -1 indicates a displacement where the burglary reduction is entirely offset by increases in the buffer zone. A WDO of zero represents a scenario where there was apparently no change in the buffer zone, or where this change could not be attributed to changes in the SDP.

It is important to note that should displacement occur, there is not necessarily a one-to-one relationship between the number of burglaries saved in one area and those displaced to another. For instance, should an offender be prevented from targeting properties in an affluent area and instead have to burgle those in a more deprived area, to receive the same financial rewards it may be necessary to commit more offences in the latter area. Thus the ratio of saved to displaced burglaries may be, for example, 1:2 or higher. For a variety of reasons, including the one just discussed, it is possible that the WDO obtained may be greater than plus or minus one.

To calculate WDO values for the entire buffer zone and for each of the five smaller buffer rings, it was necessary to calculate how many households were located in each buffer zone. This was established using information from Address Point⁵ and the GIS intersect command. The WDO for the entire buffer zone was -1.4, indicating that there was evidence of displacement and that the change in the buffer zone exceeded that in the SDP. Thus, further WDOs were computed for each of the buffer rings, these are shown in Figure 4.1. The results show that whilst there was, in general, evidence of geographical displacement there was also a diffusion of benefit in the buffer ring contiguous with the SDP boundary. The greatest evidence of displacement was observed for the second buffer ring, the effect then decreased in the subsequent rings, suggesting a possible distance decay effect.

⁵ The number of households was a proxy based upon the number of domestic postal delivery points, derived from Ordnance Surveys Address Point data.

Figure 4.1: Weighted displacement quotients for the five buffer rings



Finally, we computed a weighted displacement quotient to examine the potential geographical displacement of burglary into the non-targeted area of the SDP. The value obtained of -0.21 indicated that there was some evidence of displacement to this area but that it was fairly limited.

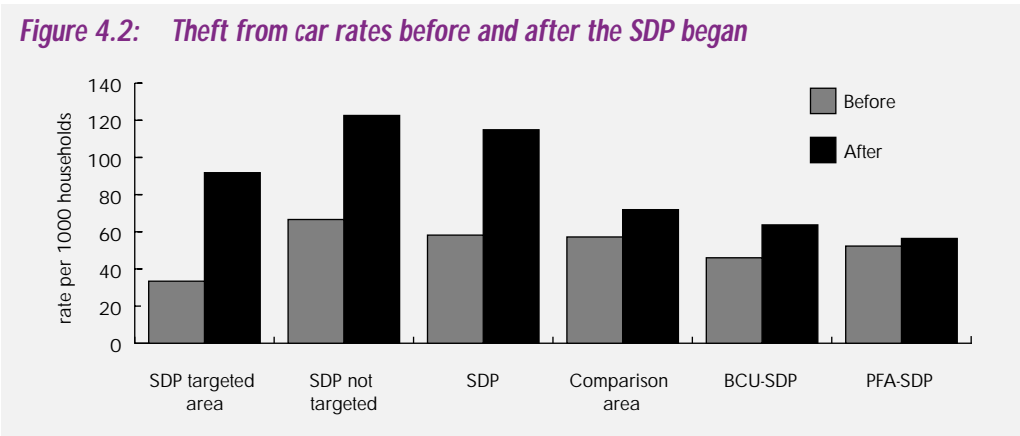
Crime switch displacement

A further type of displacement that crime reduction schemes may cause is crime switch displacement which occurs when offenders swap from undertaking burglary to committing other types of crime in an area. Rather than focusing on all types of crime, for the purposes of illustration, this section will consider the effects of SDP activity on four types of acquisitive crime: 'theft from a person', 'theft of a car', 'theft from a car' and the 'unauthorised taking of a car'. These particular crimes were selected for the following reason. Felson and Clarke (1998) have argued that opportunity plays a role in causing all crime and that according to rational choice theory (e.g. see Cornish & Clarke, 1989) the goal of criminal behaviour is to benefit the offender. Thus, it seems reasonable to suggest that following the removal of opportunities for burglary, assuming that alternatives exist, offenders would seek to commit the most similar type of crime and select the next most similar targets. In terms of alternative types of crime that offenders may decide to commit, intuitively one would expect that those listed above would represent some of the most likely candidates.

The first approach adopted here to examine the effects of SDP activity on crime-switch was to simply consider the changes in the rates of these crimes over time. One problem with calculating rates for crimes such as car theft is that of selecting an appropriate denominator. For instance, whilst the selection of a denominator for (household) property crime is straightforward, this is not necessarily the case for car crime. Ideally, one would use the number of cars that are, on

average, parked in an area. However, although there is data concerned with the number of cars owned by residents that reside within a particular Enumeration District (ED) there are a number of problems with the use of this data here. The main concern with the use of such a denominator is that it is only available at the ED level, and the analyses conducted here are concerned with effects at the sub-ED level (e.g. the SDP sub areas).

Thus, for practical reasons and to allow comparisons across different crime types (e.g. burglary and car crime), we used the number of households as the denominator. Whilst we recognise that this is not a perfect denominator we believe that it should suffice for the current purposes. For purposes of illustration, Figures 4.2 and 4.3 show the crime rates for two of the selected crime types, theft of and theft from car, for both the before and after SDP time periods.

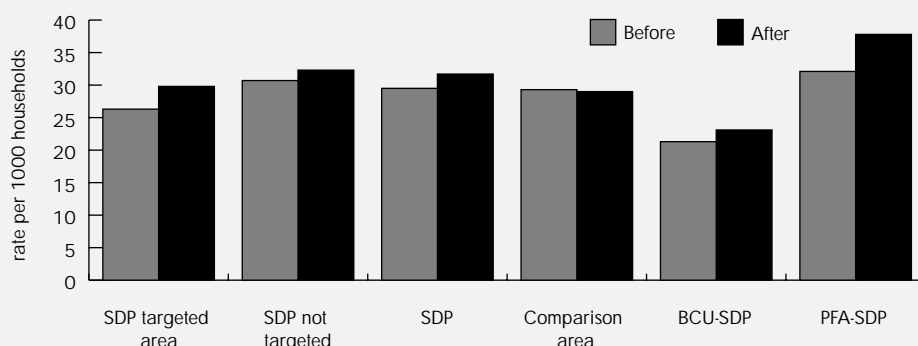


Consideration of the data for the four types of crime considered revealed that the SDP interventions appeared to have had a selective effect on the rates of other types of crime. Thus, whilst theft from a motor vehicle (shown in Figure 4.2) actually showed a considerable increase relative to the change observed in the comparison areas, theft from a person decreased somewhat, particularly relative to the BCU and PFA, whereas the crime rates for the unauthorized taking of a vehicle (not shown) and theft of car (shown in Figure 4.3) seemed to have changed in a way that was generally consistent with the patterns observed for the three types of comparison area.

Thus, the most striking effect appeared to be that observed for 'theft from car'. For instance, whilst the crime rate in the SDP was very similar to the rates for each of the three comparison areas prior to the start of the scheme, it was considerably higher for the 24 months that followed the inception of the scheme, being approximately twice as high as it was before the start of the scheme. Notably, the change experienced within the SDP was

most apparent for the three sub-areas in which the interventions were concentrated. In this area the rate increased by a factor of three, whereas, and in contrast, the change in the rates for the three comparison areas ranged from an increase of a factor of only 1.07 to 1.38. Similarly, the rate in the non-targeted area of the SDP only increased by a factor of 1.8. Hence, although there was a clear reduction for burglary in the area of the SDP in which three of the initiatives were concentrated, this reduction appears to have been accompanied by an increase in a different type of acquisitive crime, namely 'theft from car'. Thus, there appears to be persuasive evidence of crime-switch displacement as well as geographical displacement. The above analyses could, of course, be supplemented by consideration of the changes in a number of additional crime types, such as non-domestic burglary. However, the purpose of this paper is to illustrate the kinds of analyses that are possible rather than to conduct every possible analysis ourselves.

Figure 4.3: Theft of car rates before and after the SDP began



Crime switch to theft from vehicle

The above analysis has shown some evidence of potential crime switch from burglary to theft from car. In order to test whether or not this was a statistically significant effect, a beat level analysis of change in the theft from vehicle rate was conducted in a similar way to that described for burglary above. Changes in the theft from vehicle rate between the period before and after scheme inception were calculated for each of the 289 beats with 1000 or more residential properties in the Merseyside area.

As with the data for burglary, the distribution for these 'difference' scores for the 289 beats was approximately normal. This time, however, the distribution had a mean of 3.8 and a standard deviation of 17.61. Thus, on average there was a slight *increase* in the theft from vehicle rate over time. To see if the change in the theft from vehicle rate in the SDP was significant relative to

the average change observed, z-scores were calculated for each beat. The two beats making up the Liverpool SDP (beat codes C434 and C554) had z-scores of +1.71 and +3.43 respectively. Both of these z scores were significant at the 5 per cent level (one-tailed). In fact these two beats had the 14th and 3rd highest positive z- scores for all 289 beats. This shows a very significant increase in theft from vehicle for both the SDP beats. Interestingly, the z-score produced for the targeted area of the SDP alone was +3.10, which is not as significant as beat C554.

For completeness, we also calculated a WDQ for this type of crime to examine the extent to which crime-switch occurred. To do this, it was necessary to use a modified version of the WDQ formula (see Appendix 1). That is, rather than comparing the change in the distribution of one type of crime in two different areas relative to the PFA, we were considering the change in two types of crime in one area relative to the PFA. As with the above analyses, the total number of households was used as a denominator to calculate the crime rates for car crime. For the entire SDP the WDQ was -19.3 indicating that the increase in the theft from car rate greatly exceeded the change in the burglary rate. For the targeted area of the SDP, the WDQ was -0.87, demonstrating that the change in the burglary rate was similar to the increase in the theft from car rate. The results from the WDQ thus also show that there was considerable evidence of crime switch.

A likely reason that may explain why crime switch appears to be most pronounced for this type of crime is the fact that theft from a motor vehicle is probably the next most similar crime to burglary. For instance, the skills required to commit these two types of crime are roughly equivalent, and the types of goods acquired are likely to be similar both in terms of size and value, meaning that the offender should be able to sell the goods through existing channels/contacts.

In contrast, the other crime types, such as theft of an automobile, are likely to require different skills, involve different risks, and possibly involve selling the goods through different or even new contacts. Thus, from the rational choice perspective it would seem to make sense that offenders who perhaps specialise in committing burglaries would choose to steal from cars should the availability of burglary opportunities become more limited or the risks increased.

However, a potentially puzzling aspect of the above results is that it can clearly be imputed that both the WDQ and z-score analyses indicated that there was evidence of crime switch within the non-targeted area of the SDP. Since evidence suggests that offenders commit crimes within close vicinity of their home address (e.g. Wiles and Costello, 2000), one plausible reason for this may be that whilst offenders may commit burglaries in a fairly anonymous fashion (that is, once inside a property the likelihood of being identified is relatively minimal) the same is unlikely to be true for acquisitive car crime. Thus, from a

rational choice perspective, should crime-switch occur, it would make sense to commit car crimes in areas that are just outside their own neighbourhood. In support of this, in a recent study, Wiles and Costello (2000) reported that offenders tend to commit car crimes (in this case, taking a vehicle without the owner's consent) at a greater average distance from their home address than they do burglaries (the mean distances were 2.36 and 1.88 miles respectively). A further possibility is concerned with offenders' knowledge of the operational boundary of the scheme and their understanding of the initiatives being implemented. Importantly, if offenders are simply aware that something is going on in the area, but are not aware of the specifics of the intervention, then they may be more likely to avoid committing *any* type of crime in that area, meaning that should crime-switch occur it would perhaps be fairly prevalent in areas just outside the target area. Regardless of the underlying cause of this effect, it seems plausible that this form of displacement may have a geographical as well as offence specific component to it.

Furthermore, whilst changes in the burglary rate were only statistically significant at the 5 per cent level for the sub-areas, the changes in the crime rate for car crime were significant for all SDP areas (targeted, non-targeted and entire SDP). Thus, one may argue that since the changes were always significant for car crime but not for burglary, it is difficult to attribute the changes to crime-switch displacement. However, there are a number of reasons for believing they are. First, there was evident selectivity in the patterns of change. Specifically, the actual changes in crime rates, for both crime types, were greatest for the targeted area of the SDP, and the changes observed in each of the comparison areas (i.e. the comparison area, the BCU and the PFA) were almost non-existent or relatively small. Second, one reason why the changes for car crime but not burglary were always significant may be due to a statistical measurement or sensitivity issue. For example, to gain the same rewards as committing one burglary, offenders may have to commit a number of car crimes. Thus, one burglary prevented may lead to five or six incidents of theft from car. This means that although the change in the burglary rate is small and difficult to detect, the change in the theft from car rate would clearly be substantial. One way of examining this issue is to consider the findings from the 2000 British Crime Survey (Kershaw et al., 2000) concerned with the average cost of goods stolen for these two types of crime. The results indicate that the cost of goods stolen for an average burglary is £1,273, whereas the average yield for theft from car is £202. Thus, using a crude calculation, it would appear that offenders must commit at least six 'theft from car' offences to reap the same rewards as one burglary. Given this gearing ratio, we would anticipate that if crime switch did occur even a small reduction in the burglary rate would result in a fairly substantial increase in car crime. Thus, statistically it may be easier to detect changes in the latter even when changes in the former are less evident.

Heat threshold grid square analysis

It is possible to investigate the relationship between burglary and theft from vehicle in more detail by looking at the spatial distribution of these crime types within the SDP area. In order to do this, the SDP area was separated into 100 metre grid squares. Counts of burglary and theft from car were then calculated for each of these squares for the two-year period before and the two-year period after the scheme's inception. These counts were then subtracted from each other to produce a measure of change for each crime type. These changes were then mapped and the results are shown in Figures 4.4 (for burglary) and 4.5 (for theft from vehicle). For both of the figures, squares were shaded using a heat threshold technique. Thus, red or brown squares indicate that the count of crime increased between the two periods, whereas those shaded in blue represent areas where there was a reduction. Squares that are shaded white are those in which the crime rate did not change between the two periods. Figure 4.4 shows that, as expected, many of the squares within or nearby the three targeted sub-areas show reductions in the count of burglary. In contrast, Figure 4.5 shows that there were increases in theft from vehicle in these three sub-areas over the same period of time.

Figure 4.4: Changes in the distribution of burglary before and after scheme inception

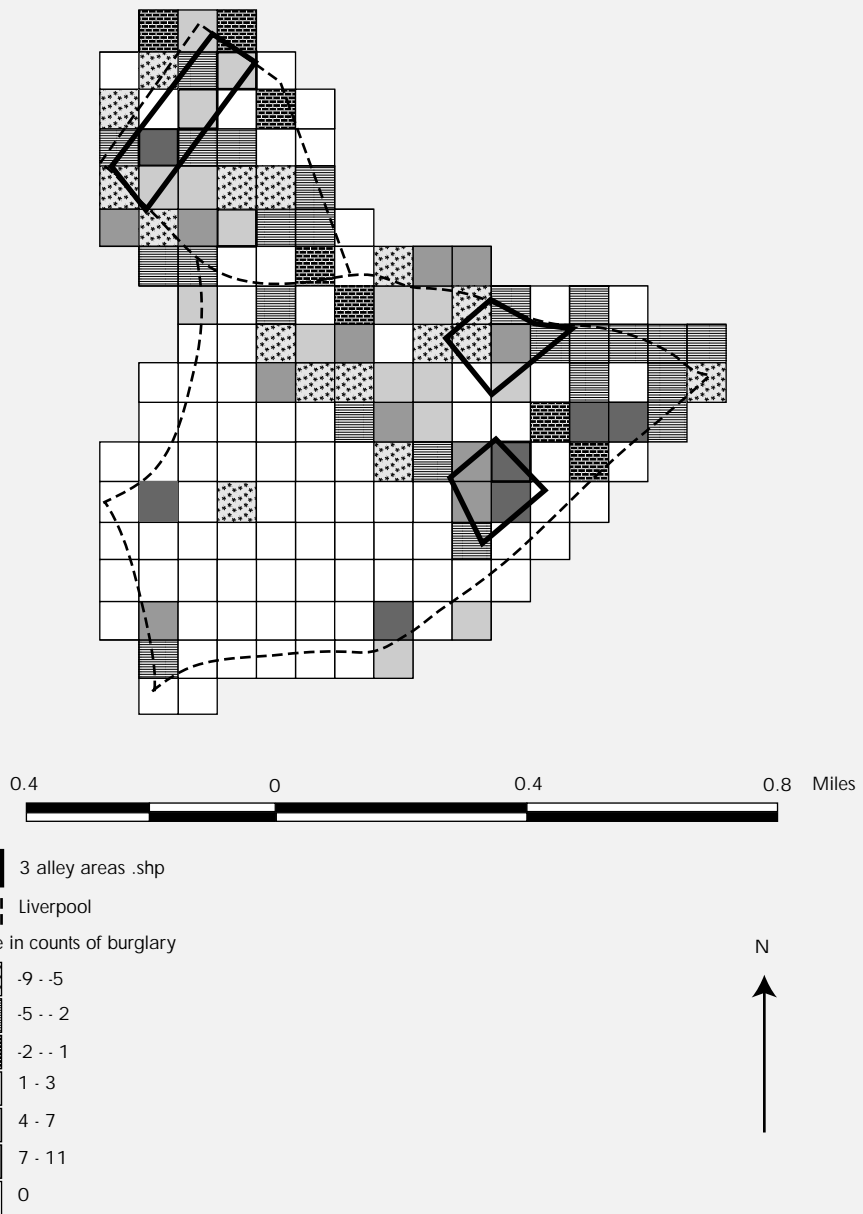
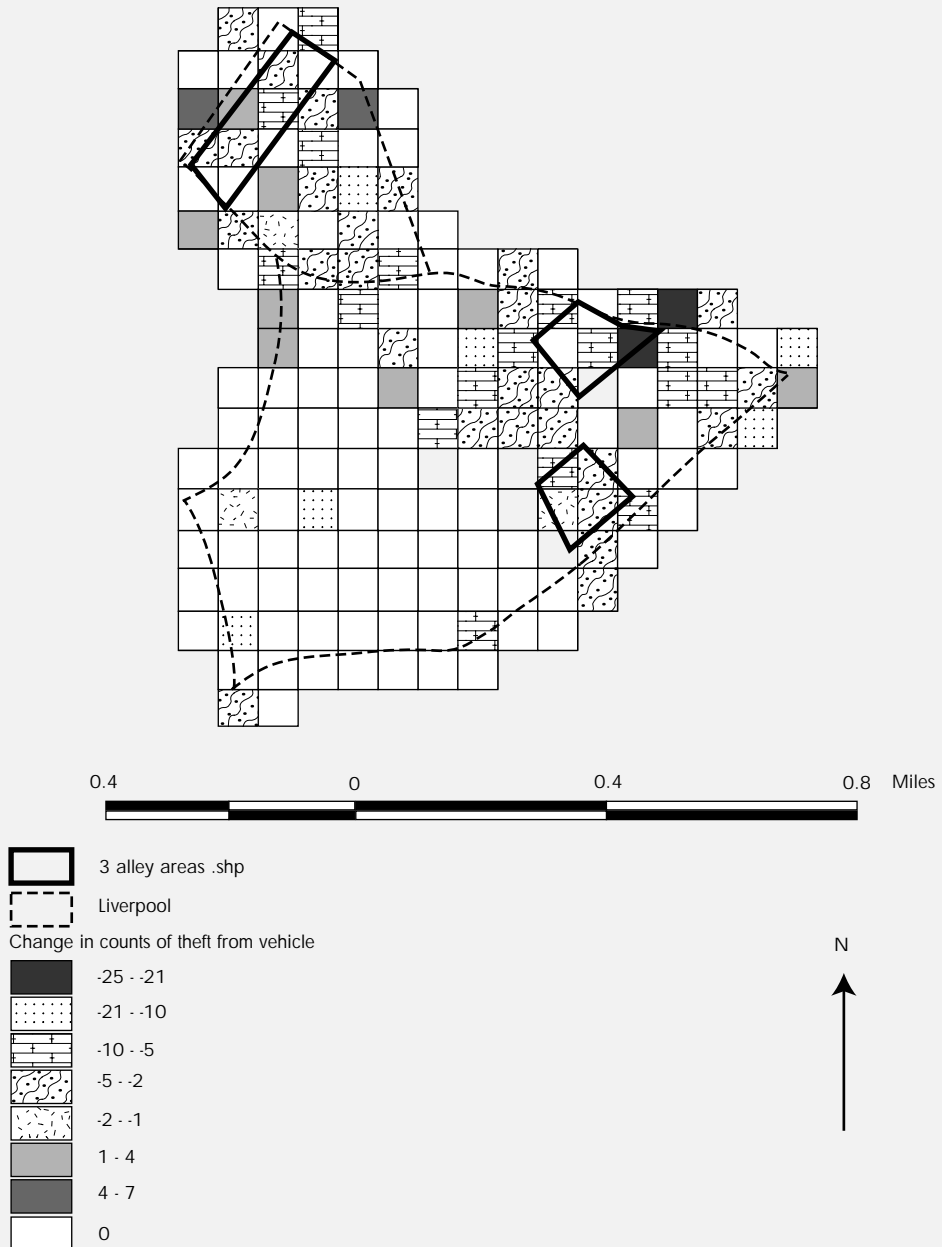


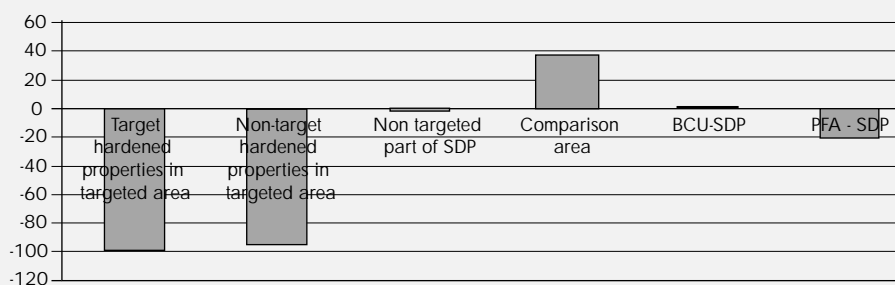
Figure 4.5: *Changes in the distribution of theft from vehicle before and after scheme inception*



Target switch

The third type of displacement to be considered is that of *target switch*, which is said to have occurred if offenders avoid properties that they may have otherwise targeted had the properties not been subject to crime reduction activity. Furthermore, offenders instead select the next available properties within the scheme boundary. For instance, if it is likely that number 10 on a particular road has received security upgrades as part of a target hardening scheme, but numbers 12–100 probably have not, then offenders may target these untreated properties instead.

Figure 4.6: Reduction in burglary rates for different groups of property



To examine this issue we calculated the number of burglaries that were committed at properties that were and were not subject to crime reduction activity within the SDP. Next we computed the change in the rates for these different groups of properties over the before and after time periods. Rather than presenting the data as a simple percentage change figure, we standardised the index of change as a function of the change observed for the houses that were subject to crime reduction activity. Figure 4.6 shows the reduction in the rate of burglary for six different types of area: the treated properties and the untreated properties located within the SDP sub areas, the remainder of the SDP boundary not subject to situational crime reduction measures, the comparison area, the BCU and the PFA. As the index of change was calculated as a function of the change observed in the treated properties, the index for these properties was set to -100% . The Figure shows that the non-targeted properties in the near vicinity of those that were treated (i.e. those within the three smaller sub-areas shown in Figure 1) experienced a large percentage reduction in their overall burglary rate relative to the treated properties. In fact, these properties saw almost as much of a decrease (95 per cent) as the treated properties themselves. There was also a slight reduction in the non-targeted part of the SDP (those outside the three sub-areas in Figure 1.1) but this was not on the scale of the non-targeted properties within the sub-areas.

In addition, this drop was not as large as that seen in the remainder of the PFA (PFA–SDP). The changes in both the comparison area and the BCU were actually positive (to differing degrees), indicating that relative to the treated properties there was an actual increase in risk in these two areas, rather than the slower decrease observed in the other areas.

It therefore appears from the graph that the non-targeted properties within the sub-areas benefited from the fact that they were located nearby to houses that had received treatment. This represents evidence of diffusion of benefit, and suggests that the possibility of target switch to other properties within the intervention areas is unlikely. It also appears that the diffusion of benefit is fairly localised in its nature because there was far less of a (relative) reduction in the burglary rate in the part of the SDP outside the three sub-areas. This is likely to be demonstrating a spatial proximity effect, suggesting that offenders are aware that crime reduction activity is happening in the area but are not sure which specific houses have been targeted and therefore avoid all houses in the immediate area of the intervention. This has clear implications for the planning of crime reduction initiatives, particularly for maximising the effects of limited resources.

Measuring the effects of a single intervention

This section considers the effectiveness of individual interventions by examining the changes in the burglary rate for protected properties over time. It begins by using information on the actual location of *target-hardened* properties within the Liverpool SDP area to illustrate the methodology developed and then proceeds to consider the effectiveness of the other interventions. The address of each property that received target-hardening was supplied by the SDP team. These were then allocated easting and northing co-ordinates using Address Point information (a geographical database). Briefly, the addresses were cleaned and rewritten in Address Point structure and then matched with the Address Point data in a GIS, using the unique combination of house number and postcode, fields that were common to both files. These data were then mapped using a GIS. Visual inspection of the map revealed that the target-hardened properties were almost exclusively located within the three sub-areas of the SDP.

In order to evaluate the effectiveness of target hardening in reducing burglary, the information on the location of target-hardened properties needed to be cross-referenced with information on burglaries occurring at these addresses. The most accurate method of achieving this was by restructuring the burglary data in the same format as the target hardening information. A FORTRAN program was therefore produced that re-formatted burglaries into Address Point format. Then, using address-matching software produced for the evaluation, the recorded crime and target-hardening databases were searched and any burglaries that had occurred in target-hardened properties were identified. Each of the burglaries had date information attached to them, which enabled a count to be produced of the number of burglaries against target-hardened properties that had occurred before and after inception of the Liverpool SDP scheme.

Table 5.1 summarises the raw count of incidents both before and after the SDP became active (simply searching for incidents before and after 1st April 1999). Although results shown in Table 5.1 are produced on an individual level, to preserve anonymity the information was aggregated to give the total number of times that all target hardened properties were victimised before and after locks were fitted.

Table 5.1: Domestic burglaries and repeats in target hardened properties before and after SDP became active

	Count of incidents
Before SDP (Apr 97-Mar 99 inclusive)	55
After SDP (Apr 99-Mar 01 inclusive)	62

Table 5.1 shows that the total number of burglary incidents appears to have actually increased in the target hardened properties since inception of the SDP. At first sight, this seems to indicate that the target-hardening scheme was not effective in reducing burglaries. However, it is important to note that it is not possible to assume that all of the target-hardened properties received their measures by 1 April 1999. In fact, a simple analysis of the data revealed that the implementation of the target-hardening intervention occurred over a fairly long time period (between 13 April 1999 and 30 September 2000). The most active period of target hardening took place between 1 March 2000 and 14 August 2000, during which time 75 per cent of the properties were target-hardened. Thus, it was likely that the analyses presented in Table 5.1 may have been misleading. For this reason, we conducted further analyses using data concerned with the date on which the target hardening of each property took place.

Thus, in order to produce a more sensitive analysis, each of the properties were tracked individually to establish how many of the 62 burglaries carried out after the inception of the scheme had occurred in properties before their individual date of target hardening and how many had occurred after this date. Table 5.2 reveals that in fact, 43 of the 62 burglaries occurred at properties before they were target-hardened; only 19 occurred in target-hardened properties.

One potential problem with this analysis as presented so far, is that it does not compare like with like in terms of the time periods that elapsed before and after target hardening. For example, if a property was target hardened on 13 April 1999 it will have more opportunity to be burgled before 31 March 2001 than a property that was target hardened on 30 September 2000. In order to control for this, the number of days between 1 April 1997 and the date of target hardening and the number of days between this and 31 March 2001 were calculated for *each property*. This information was used to produce statistics on the total number of days for which the entire group of target-hardened properties were unprotected (by adding together the 'before' periods for all properties) and the total number of days for which they were protected (by adding together the 'after' periods). This data

was then used as a denominator to produce a standardised rate which controlled for the period of victimisation opportunity for each household. These ‘opportunity dependent incident counts’ are shown in Table 5.2. The results demonstrate that, even when differences in victimisation opportunity have been accounted for, there is a difference in the number of incidents happening before and after target hardening. In fact, target-hardened households were at almost half of the risk of unprotected houses in the same area. This is a particularly important finding given that research consistently demonstrates that victimisation predicts future risk (e.g. see Pease, 1998), and the fact that part of the selection criteria for target hardening included identifying previously victimised households. Thus, ordinarily the target-hardened properties would be precisely those that would be expected to be at a heightened rather than reduced risk. These results suggest that the target hardening intervention had been successful.

Table 5.2: *Revised table examining burglaries that happened after inception date in relation to their individual target hardening date*

	Count of incidents	Number of days for all target hardened properties	Opportunity dependent count of incidents
Before TH	98	394665	24.83*
After TH	19	135285	14.04*

*To ease interpretation these are scaled up by 100,000

A further extension to this methodology is the translation of the information presented in Table 5.2 into a quantification of the outcome of the particular intervention from the point of view of the number of burglaries reduced or prevented by the measures taken. Table 5.3 shows the steps taken to calculate this outcome. As demonstrated above, the first stage was to produce opportunity-dependent counts of incidents. In this case, the counts have been scaled to relate to a ‘virtual year’ for the properties concerned, which produces slightly different results from those in Table 5.2, which used a different scaling factor. This ‘virtual year’ is calculated by multiplying the number of target hardened properties by the number of days in a year. For the 363 target hardened properties therefore, 132495 days makes up a virtual year. This scaling was undertaken because it was sensible to have a meaningful period of analysis for the production of outcomes. In order to produce outcomes, the number of burglaries occurring after target hardening required comparison with an expected rate. An expected rate was produced by taking into account changes in the wider PFA over time. Therefore;

$$\text{Expected burglaries} = \frac{\text{Average PFA count before target hardening}}{\text{Average PFA count after target hardening}} \times \text{number of burglaries in properties before target hardening}$$

(Note that the area used is the Police Force Area minus the Basic Command Unit which contains the SDP in order to avoid confounding this ratio by including areas possibly affected by the activity of the SDP scheme).

Table 5.3: Outcomes for target hardening scheme

	Count of incidents	Number of days for all target hardened properties	Opportunity dependent count of incidents	Average PFA-BCU count for quarters before and after target hardening	Expected no of burglaries after	No burglaries prevented by scheme
Before TH	98	394665	32.90*	2510		
After TH	19	135285	18.61*	2407	31.55	12.94

* These are for virtual years (132,495 days for 363 households)

This expected rate therefore reflects what we might expect the incident count to be if nothing occurred in the SDP. That is, if the proportion of burglaries committed in the PFA that were concentrated in the SDP remained stable over time. In order to calculate the outcome (or the number of burglaries saved by the scheme) in Table 5.3 the observed number of burglaries occurring after target hardening was simply subtracted from the expected number. Table 5.3 therefore shows a saving of 13 burglaries in one (virtual) year for the 363 properties involved in the intervention.

Measuring the effects of multiple interventions

So far in this section, the analysis of outcomes at the individual level has only investigated the effect of target hardening on levels of burglary. The reality is that other initiatives, such as smartwater and alleygating may also have an effect at this level. Furthermore, some of the households that had been target-hardened were also protected by smartwater and/or

allegating. In order to try to separate out the effects of these interventions, a database was produced that contained all of the households that had been involved in at least one of these three interventions. For each household, there was a dummy variable that indicated whether the property had been target hardened, smart-watered or allegated and data concerned with the dates on which these measures had been installed.

Using the address matching software, this database was then matched against individual burglary data for the period between 1 April 1997 and 31 March 2001. In a similar method to that described above, the date of each burglary was compared with the date of installation of the measures taken at each property. Table 5.4 below shows the results of this analysis. The table shows that overall there were 500 individual households that had been treated by at least one intervention. The most common situation was that properties were target hardened without any other treatment (168 properties). There was also a substantial amount of cases in which properties received both target hardening and smartwater (136 properties). Less common were individual properties that had received all three interventions (31 properties), allegating and target hardening (28 properties) or allegating and smartwater (7 properties). The number of burglaries saved by each of the combinations of treatment was calculated using the opportunity dependent rate method described above. As above, these outcomes were calculated for a 'virtual year' for that number of households. For example, for allegating there were 76 treated properties, which meant that a virtual year would be equivalent to $76 \times 365 = 27740$ days. The savings shown in Table 5.4 should therefore be taken as being for a virtual year for the particular number of properties receiving that combination of interventions.

By adding up the outcomes, it can be seen that overall across the different combinations of interventions, there was a saving of approximately 12 burglaries. It is interesting to compare the different savings across the different types of treatment. It appears from Table 5.4 that undertaking target hardening, either on its own or in combination with one or more other intervention, appears to be a particularly effective treatment. In fact, according to the figures target hardening on its own appears to be more effective than using it in combination with other measures. However, this may be due to the fact that more households received target hardening alone than those using combinations of measures. The two combinations of interventions that appeared least effective was smartwater alone, which showed an increase of 2.49 burglaries over the expected rate, and allegating and Smartwater, which showed no change, although the number of cases in the latter category (7 properties) was too small for reliable analysis.

Table 5.4: Outcomes for different types of treatment

Type of treatment	No of hhlds	Count of incidents	Number of days elapsed	Opportunity dependent count of incidents	Average PFA-BCU count of incidents	Expected burglaries after	Burglaries saved by scheme
Alleygating							
Before	76	19	87856	6.00	2510		
After	76	4	23104	4.80	2407	5.75	0.95
Virtual yr = 27740							
Target hardening							
Before	168	52	182845	17.44	2510		
After	168	10	62435	9.82	2407	16.72	6.9
Virtual yr = 61320							
Smartwater							
Before	54	7	61836	2.23	2510		
After	54	4	17004	4.63	2407	2.14	-2.49
Virtual yr = 19710							
Alleygating and target hardening							
Before	28	7	30789	2.32	2510	2.22	1.21
After	28	1	10091	1.01	2407		
Virtual yr = 12045							
Alleygating and Smartwater							
Before	7	0	7471	0	2510	0	0
After	7	0	2749	0	2407		
Virtual yr = 2555							
Target hardening and Smartwater							
Before	136	30	148291	10.04	2510	9.63	2.71
After	136	7	50239	6.92	2407		
Virtual yr = 49640							
All 3 interventions							
Before	31	9	32740	3.11	2510		
After	31	1	12520	0.90	2407	2.98	2.08
Virtual yr = 11315							
Overall							
Before	500	124	551828	41.01	2510		
After	500	27	178142	27.66	2407	39.33	11.67
Virtual yr = 182500							

An important final consideration in assessing the impact of the RBI is the role played by other crime reduction and regeneration initiatives that are operating in the area. The SDP target area was originally chosen so that it would not co-incide with the European Union Objective 1 areas. In doing so, it was ensured that the SDP did not overlap with areas in which the Safer Merseyside Partnership, a nine-year crime reduction programme, was operational. However, there is the possibility that other crime reduction efforts, such as those of Merseyside Police Force and those laid out in the Crime and Disorder strategies for the district of Liverpool, might have some impact on burglary rates in the target area. For this reason, information concerning such schemes was collected. Some of these had a community safety element and their geographical boundary covered both the Liverpool and Merseyside areas. Thus, it is possible that some of these projects could have had a potential effect on the crime rates within and nearby the Liverpool SDP area. For instance, a Health Action Zone parenting support project and a youth exclusion project had a city-wide remit, and hence both operated in the SDP area. Furthermore, a Streetsafe police initiative and the Dingle Community Regeneration team project's CCTV initiative also operate in the SDP area. All the schemes mentioned above were implemented at least partially within the timescale of the Liverpool SDP. It is difficult to assess the effect of these schemes on crime rates within the SDP area without having specific information on the inputs and outputs for these schemes. However, since all the schemes mentioned above were implemented across wide areas of the city of Liverpool, it is reasonable to assume that the BCU, the comparison area and the buffer zones that have been used in the analyses described here would all have been affected by these initiatives. This means that to a certain degree the influence of other initiatives was controlled for in the analyses. It would be more problematic if any of the other crime reduction initiatives had focused on a far smaller geographical area of which the SDP (but not the comparison areas, or vice versa) was a part.

This paper has illustrated the power of disaggregate data analysis in the evaluation of the effectiveness of burglary reduction schemes, and has shown that the use of aggregate level information alone may produce misleading results. It has also presented new methods for quantifying the outcomes of such schemes. These methods include new techniques for measuring changes in the burglary rate, assigning statistical significance to such changes, assessing the degree to which action causes crime displacement and a way of isolating burglary reduction outcomes that can be attributable to specific interventions undertaken.

The authors would like to emphasise that it should be possible to use techniques such as those described above to assess both the impact of burglary reduction schemes in other areas, and, in some cases, the impact of other crime reduction schemes. For instance, similar techniques could be used to assess the statistical significance of schemes aimed at reducing car crime or reducing crime through CCTV surveillance. The ability to undertake any such ventures relies on the availability of accurate, individual level recorded crime information.

Considering the scheme used to illustrate the techniques presented here, whilst the purpose of this paper was to focus on the methods developed, some discussion of the scheme itself and relevant policy implications is clearly warranted. However, before discussing the effectiveness of the scheme it is necessary to comment on the implementation of the interventions. Considering the target hardening and property marking initiatives, these were successfully implemented within the time period studied. And, analyses of the dates on which target-hardening surveys took place indicated that the majority did so immediately after a burglary, illustrating that the targeting strategy employed was efficient. In addition, since research (see Pease, 1998) illustrates that the majority of repeat incidents of burglary occur swiftly, the approach adopted would have ensured that properties were protected during the period that they were most vulnerable. Thus, the effectiveness of the scheme was not compromised by an inappropriate targeting strategy.

In contrast, the alley-gating scheme was not fully realised during the evaluation period and this will undoubtedly have had an impact on the effectiveness of the scheme. As noted above, because of legal reasons only ten of the intended 69 gates were fitted during the period considered. These gates secured one block of 125 houses. Problems were also experienced by the offender-based scheme, as follows. First, due to initial problems in recruiting a police officer, the scheme did not become operational until January 2000.

Second, for the above period, only six offenders had participated in the scheme. Third, all of the offenders who took part in the scheme had recently been released from prison on licence. Thus, it is plausible that the offenders operating in the target area for both the pre- and post-implementation periods did not actually take part in the scheme. Thus, it is difficult to see how the scheme could have had an effect on the behaviour of those offenders who were responsible for the crime rate in the target area within the time period studied. Finally, for these and other reasons, it is worth noting that behaviour modification programmes may well require a much longer period than situational crime reduction initiatives to produce reliable and/or sustainable effects, and thus it is our opinion that whilst this intervention may have produced reliable results in terms of changing the behaviour of the offenders who took part in the scheme, it is unlikely to have impacted upon the crime rate in the SDP at this stage.

Notwithstanding these initial implementation problems, the analyses presented above suggest that, to some extent at least, the scheme was successful in reducing the burglary rate in the targeted area. Although the reduction observed across the entire SDP was statistically non-significant, the change apparent in the three sub-areas in which the situational crime reduction measures were geographically focused clearly was. In terms of repeat victimisation, there was a clear reduction across the entire SDP, although this again was most evident in the three targeted sub-areas.

Considering the time period during which the scheme appeared to be most effective, perhaps not surprisingly this appears to have occurred during the most intensive implementation phase of the scheme (see Figure 2.3). However, the crime rate rose steeply in the final quarter of the evaluation period. Assuming that this was a reliable increase, this may suggest two possibilities regarding the mechanism through which the scheme had an effect. First, it is possible that the effect was simply not sustainable and that offenders discovered methods of circumventing the measures taken. Alternatively, it is possible that the change in the SDP may have been attributable to a realisation on the part of offenders that ‘something’ was going on (or was about to) in the target area which would affect the risk of being caught, an effect generally referred to as the ‘Hawthorne effect’ (see Mayo, 1933; see also Smith et al, forthcoming). In this latter case, the reduction observed would be assumed to result from a change in offenders’ perceptions of the risks involved in committing crimes in the area, rather than because of the actual difficulty in gaining access to the protected properties. In support of this possibility, in a forthcoming book chapter that considers the role of the Hawthorne effect in crime reduction schemes, Smith et al report that of the 52 evaluations considered, 40 per cent showed evidence of a reduction in the crime rate in advance of the physical implementation of the interventions, an effect that Smith et al refer to as an *anticipatory benefit*. Unfortunately, it is beyond the scope of the current paper to determine which of the

two explanations (if not both) is valid here. To do so would involve the analysis of the crime rate over a much extended time period, and would also preferably involve the interviewing of offenders who operate in the target area. However, recent work undertaken by the authors has highlighted a fairly substantial amount of evidence that publicity does have an important role to play in crime reduction (see Johnson and Bowers, forthcoming).

Irrespective of the mechanism that caused the reduction in the burglary rate, it is apparent from the analyses presented above that this reduction appears to have been coincident with two types of displacement (geographical and crime switch) and three types of diffusion of benefit (geographical, repeat victimisation and target-switch). The fact that there was both a diffusion of benefit as well as displacement is an interesting finding with important (policy and theoretical) implications. The following paragraphs will discuss these different patterns in turn, beginning with the geographical effects.

Analyses of the change in the burglary rates for the five buffer zones indicated that for the first buffer ring there was a diffusion of benefit, with houses within this zone experiencing a reduction in the risk of burglary relative to their previous risk. One reason for this may be the result of offenders realising that something was going on in the general area but not being aware of the exact boundary of the scheme. This is an important finding as it suggests that the preventive effects of situational crime reduction measures may extend to unprotected houses within close proximity of a scheme. This possibility is given strong support by the finding presented in Figure 4.6 which showed that within the targeted area of the SDP, the non-target hardened properties experienced almost an equivalent reduction in the risk of victimisation to those that received target-hardening measures. Thus, the possibility exists that the effectiveness of many situational crime reduction interventions may be increased by adopting targeting strategies that give the illusion of a greater area of coverage. This may be achieved in a variety of ways including the use of disinformation to offenders, or the use of more diffuse scheme boundaries.

Considering geographical displacement, it was apparent that following the start of the scheme the burglary rate in the second buffer zone increased dramatically but that the increase observed across successive buffer zones declined, conforming to a distance decay pattern. Thus, if it can be assumed that these changes were the result of displacement, in line with findings concerned with offenders travel to crime patterns (e.g. Wiles and Costello, 2000), and the familiarity decay theory of Eck (1993), it would appear that when offenders avoided the SDP they tended to target properties located only a short distance away from the scheme area, but not those immediately adjacent to the SDP. One possible reason why geographical displacement appears to have been so evident may be due to the fact that the

scheme was geographically concentrated into relatively small areas, thereby meaning that, for offenders, the effort involved in selecting alternative targets (e.g. those 500m away) would have been relatively minimal. If this is the case, then had the resources been distributed just as intensively but over a larger area, evidence of geographical displacement may not have been so apparent. However, unfortunately this remains speculation and further research would seem to be warranted.

Nevertheless, taken together, these findings may provide useful insights into how scarce resources might be geographically targeted. For instance, one approach might involve defining geographical concentric rings (or other geographies) and to deploy measures in some areas but not others. On the basis of the above findings, it may be the case that targeting one ring would produce a diffusion of benefit that would reduce the risk of burglary in the subsequent area. However, this may heighten the risk to properties located in the next area, and thus it would make sense to target resources into this area. By adopting this, or a variant of such a strategy it may be possible to protect many more houses than those that receive situational crime reduction measures, thereby increasing the cost effectiveness of limited resources. This possibility needs further investigation and issues such as the ratio of treated to untreated houses necessary to cause this effect would need to be established through evaluated trails.

Another interesting finding reported above was the apparent reduction in the risk of repeat victimisation both within the targeted and non-targeted areas of the SDP. Within the targeted area, this may be attributed to offenders being deterred from attempting to burgle previously victimised properties following the discovery that the physical security of those properties had been improved. However, since target-hardening was almost exclusively focused within the targeted area of the SDP, this explanation simply cannot account for the change observed in the non-targeted part of the SDP. Thus, it is plausible that the change in the risk of repeat victimisation within the latter area was attributable to a diffusion of benefit, whereby offenders perceived that the effort involved in targeting previously victimised properties exceeded the likely benefits. This finding is particularly important given that research (e.g. Johnson et al, 1997) consistently demonstrates that, in general, the risk of victimisation effectively doubles following an initial burglary.

With respect to crime-switch displacement the findings were much more negative, with there being significant evidence of this form of displacement. Specifically, for the four types of acquisitive crime considered, it was clear that the rate for one of these, theft from car, increased significantly and at a rate that exceeded that observed across the rest of the police force area. As discussed above, offenders may have chosen to increase their

activities in this type of crime as in many ways it represents the most similar alternative to burglary. Although it would be useful to replicate this result before drawing any firm conclusions, one clear implication of this finding is that when implementing crime reduction schemes it is important to anticipate how an intervention might change an offender's criminal activities, and attempt to simultaneously reduce opportunities for alternative types of crime. For instance, adopting a more holistic approach such as using CCTV cameras in concert with target-hardening may have a greater and more pervasive effect than any single type of intervention.

One important consideration in any attempt to reduce crime through the implementation of an initiative is the degree to which such activity is cost effective. In the context of the RBI discussed in this paper, this issue has warranted a complete research project in itself, the results of which are given in detail elsewhere (Mallender et al, 2002). However, it is worth briefly voicing some concerns regarding the cost effectiveness of the current scheme at this point. The results above have shown that the measures adopted prevented 12 burglaries at treated properties in the scheme area over the course of the intervention. The Home Office gives a mean cost of a burglary at £1,273. However, when all costs associated with the anticipation of crime, as a consequence of crime and in response to crime are accounted for, the average cost of a burglary becomes £2,300. A question that follows from this asks whether this reduction of 12 burglaries is enough to justify the cost of all the measures and their implementation, the geographical displacement and the displacement to other types of crime that have been observed.

In economic terms, before considering the costs of displacement, and considering only the situational measures of alley-gating, target hardening and smartwater, the results look quite positive. Mallender et al (2002) show that the number of burglaries that would need to be prevented to make this combination of interventions break-even financially would be nine for the Liverpool scheme. However, these calculations omit the offender-based scheme, which was far more expensive to implement. In addition, break-even costs have yet to be calculated that take any displacement and diffusion of benefit into account. The results presented above indicate that the added costs of displaced crimes might be quite substantial.

However, the cost effectiveness of a scheme is not the only consideration that needs to be made. It is more difficult, for instance, to put a price on fear of crime and how much this may have been influenced by the preventative measures taken. Furthermore there are issues of equity and territorial justice that should be considered. For instance, displacement can be seen as being of value to those who have avoided victimisation (e.g. Barnes, 1995). Barr and Pease (1990) use the phrase 'benign' displacement to characterise crime-switch to

alternative crimes that may be less serious than those prevented. Burglaries may also be displaced into lower crime neighbours, which would even-out the distribution of crime and make it (arguably) more equitable. It is evident that further studies are required to answer the question of whether such crime reduction projects are truly worthwhile, and how it is possible to quantify the value of, for instance, reducing fear of crime.

The main purpose of the current paper was to illustrate some new (and some not so new) techniques that may be used in the evaluation of crime reduction schemes. However, the findings reported provide useful insights into the effects of such schemes, particularly in relation to displacement/diffusion of benefit. Whilst displacement is clearly a negative side-effect of crime reduction activity, it is important to understand how and when it occurs, only then can we attempt to do something about it. However, to do this it is necessary to be able to quantify or describe such a phenomenon in a systematic way, using techniques such as those describe here, so that the results of independent studies can be directly compared. It is our hope that more research will be conducted to address this issue so that the results may be used to inform policy, rather than to be used as a reason not to implement situational crime reduction measures.

A final point to note is that there are many different techniques available for use in evaluation of crime reduction projects. This report has given a quantitative angle on such evaluation, and has focused on the ways in which secondary data can be used to answer questions such as "did crime reduce". It has gone into less detail regarding the mechanism by which crime is reduced in certain areas, and the characteristics of the areas where schemes were successful in terms of their contextual makeup (e.g. socio-economic variables) and the process by which the scheme was implemented. These are important concerns of evaluation research, and have been addressed by researchers from the Northern Consortium area elsewhere.

In a forthcoming paper (Bowers and Johnson, in press) we review the extant literature concerned with the displacement of crime and diffusion of benefits. In particular, we discuss the techniques that have been used to measure these phenomenon and the potential problems associated with these methods. Consequently, we present a new standardized technique, the weighted displacement quotient (WDO), which can be used to measure either phenomena. The rationale and assumptions underlying this technique are presented in full in the forthcoming paper. However, to enable evaluators to use this technique now, the equation for the WDO is presented below.

Formula for the weighted displacement quotient

The equation used for comparing the rate in the buffer to the police force area is given by:

$$\text{Rate in (buffer zone)}/\text{rate in (PFA- buffer zone - SDP)} \quad (1.1)$$

The index is then weighted using a measure that compares the rate in the target area to that in the police force area:

$$\text{Rate in SDP}/\text{Rate in (PFA-buffer zone-SDP)} \quad (1.2)$$

Giving a weighted measure of:

$$\begin{aligned} &\text{Rate in (buffer zone)}/\text{rate in (PFA-buffer -SDP)} \\ &\text{Rate in SDP}/\text{Rate in (PFA-buffer zone-SDP)} \end{aligned} \quad (1.3)$$

However, in its current form this index only looks at the differing proportions in the various areas at one time point. And, consequently, as the term 'rate in (PFA-buffer zone-SDP)' appears in both the numerator and denominator components of the equation for the same time point, it cancels itself out. In order to detect displacement, the situation after the crime reduction scheme became active needs to be compared with the situation before. If displacement has occurred we would expect the numerator of the equation above to increase over time and the denominator to decrease – in other words for the scheme to be

successful and the proportion of crime committed in the buffer zone to increase. If the scheme is not successful, theoretically we would not expect to observe any evidence of displacement or diffusion of benefit, and hence it is unlikely that any change in the buffer zone can be attributed to activity within the scheme. Therefore, if there is no indication of a reduction in crime within the SDP it is inappropriate to attempt to interpret any changes in terms of potential displacement or diffusion of benefit.

In order to look at changes in proportions over time the weighted displacement quotient compares the situation after implementation (t_1) with the situation before (t_0) using the following formula:

$$\frac{\{Rate\ in\ (buffer)/rate\ in\ (PFA-buffer-SDP)\}_{t_1} - \{Rate\ in\ (buffer)/rate\ in\ (PFA-buffer-SDP)\}_{t_0}}{\{Rate\ in\ SDP/Rate\ in\ (PFA-buffer-SDP)\}_{t_1} - \{Rate\ in\ SDP/Rate\ in\ (PFA-buffer-SDP)\}_{t_0}} \quad (1.4)$$

Note that in this formulation of the equation, the term '(PFA-buffer zone-SDP)' no longer cancels itself out as it did in equation 1.3.

Further details regarding the WDO technique may be obtained from the authors, email: kjb@liverpool.ac.uk or S.D.Johnson@liverpool.ac.uk.

Appendix 2

Counts of single and repeat incidents of crime

Area	Before		After	
	Single	Repeat	Single	Repeat
SDP Targeted	129	13	87	5
SDP not targeted	342	37	350	27
SDP	471	50	437	31
Comparison	285	30	316	39
BCU-SDP	183	18	183	19
PFA-SDP	23700	1977	21998	1861

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Pushing back the boundaries: new techniques for assessing the impact of burglary schemes - summary

Kate Bowers

Shane Johnson

Alex Hirschfield

summary to Home Office Online Report 24/03

The views expressed in this report are those of the authors, not necessarily those of the Home Office (nor do they reflect Government policy).

Pushing Back the Boundaries: New Techniques for Assessing the Impact of Burglary Schemes

Shane Johnson, Kate Bowers and Alex Hirschfield

Introduction

This paper is a result of evaluation research undertaken in the North of England, commissioned by the Home Office to assess the impact of burglary projects funded under the first round of the Burglary Reduction Initiative. This paper, which focuses on one burglary scheme undertaken in Liverpool, illustrates some of the new techniques developed for the evaluation and demonstrates the power of using disaggregate, or individual level burglary data in assessing the impacts and outcomes of such schemes. It also shows that very different, potentially misleading, conclusions may be drawn when analyses are conducted that use aggregate level information only.

The Liverpool case study

The Liverpool Strategic Development Project (SDP) employed four different interventions, as follows:

- Target-hardening scheme: installation of physical security measures, e.g. mortice locks, door chains and window locks to vulnerable properties
- Alley-gating scheme: installation of security gates across alleyways to control access to vulnerable target areas
- Property marking scheme
- Offender supervision scheme

However, only the offender supervision scheme operated within the entire target area. In contrast, the three situational crime prevention interventions were almost exclusively concentrated within three smaller sub-areas within the operational boundary of the SDP. Thus, the analyses presented below consider changes in the burglary rate not only for the entire SDP but also for the targeted

area of the SDP - the area in which the greatest changes might be anticipated.

Changes in the burglary rate

Disaggregate level data concerned with burglary, covering the period 1 April 1997 to 31 March 2001, was obtained for the county of Merseyside. This data includes the following fields of data: a unique crime reference number; crime code; the address where the burglary took place; an Easting and Northing grid reference accurate to within one-metre; and, the date and time of the offence.

For the reason discussed above, using a Geographical Information System (GIS) we calculated crime rates for both the sub-area within the SDP where the situational crime prevention measures were concentrated and, for the remainder of the SDP that had received very little attention in this respect. Figure 1 shows the burglary rates for the period before and after inception of the Liverpool SDP (i.e. 1 April 1997 - 31 March 1999 and 1 April 1999 - 31 March 2001 respectively) and three different comparison areas. One of these areas (subsequently referred to as the 'comparison area') was a police beat that had the same socio-demographic characteristics as the SDP.

There are a number of clear patterns evident in Figure 1. Firstly, the burglary rate in the Police Force Area (PFA) showed only a slight reduction over time; the crime rate in the police Basic Command Unit (BCU) remained stable¹, and the rate in the comparison area

¹ BCUs are sub-divisions of PFAs. Both types of areas are police administration areas. To give some idea of scale, the Liverpool SDP, BCU and PFA cover 3317, 82668 and 551021 households respectively.

increased. In contrast, the burglary rate in the entire SDP saw a reduction over time. However, consideration of the reductions observed for the targeted and non-targeted sub-areas of the SDP reveals that there was a differential effect in these two areas, such that whilst there was a considerable reduction in the area(s) subject to situational crime prevention, there was a much more limited effect in the non-targeted areas.

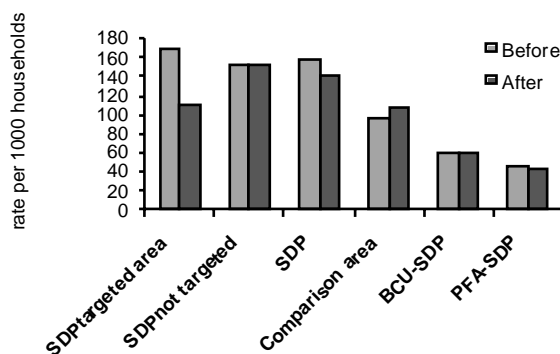


Figure 1 Burglary rates using cleaned data before and after the SDP began

Statistical significance of change in the burglary rate

Whilst the above results revealed that there was a change in the burglary rate for the SDP, they do not show whether this change was statistically significant or simply due to random fluctuation. One way of testing this is by comparing the reduction in burglary in the target area with the change observed in a series of comparison areas. Since the SDP was composed of two police beats it was decided that police beats would be the best unit of analysis. Thus, the burglary rate before and after the inception of the Liverpool scheme was calculated for each of the police beats in the Merseyside area.

Analyses revealed that the distribution of these 'change' scores conformed to a normal distribution, having a mean of -3.2 and a standard deviation of 12.72. Thus, on average, there was a slight decrease in the crime rate over time. To see if the change in the burglary rate in the SDP was significant

relative to the average change observed, z-scores, which measure how many standard deviations above or below the sample mean an observation is, were calculated for each beat.

The Liverpool SDP was composed of two beats (beat codes C434 and C554) and these had z-scores of +0.37 and -1.53 respectively. The latter z-score had a p value of 0.12 (two-tailed), indicating that the decrease in the burglary rate was marginally non-significant at the 10 percent level. In addition, a z-score was calculated for the targeted sub-area of the SDP. This had a value of -3.40 which is statistically significant at the 1% level (two-tailed), indicating that there was a significant change in this area that exceeded the average change. Thus, there were significant reductions in the burglary rate for the targeted sub-area of the SDP and one of the police beats.

Repeat victimisation

To examine repeat victimisation the burglary data discussed above were analysed using software developed by the researchers (see Johnson, Bowers & Hirschfield, 1997). Figure 2 shows the levels of repeat burglary in each of the areas for the before and after time periods. It is apparent that, in general, levels of repeat victimisation increased over time (1% in the PFA and 4% in the BCU). However, in the SDP, the level of repeat victimisation fell by around 29%. Moreover, for the SDP sub-area the level fell by around 40%, meaning that for this area, the level of re-victimisation fell from a figure which was initially higher than that for the PFA, to a level that was considerably lower than that for the PFA.

Interestingly, whilst the crime rate did not show much of a reduction in the non-targeted areas of the SDP, the level of repeat victimisation did (25% reduction). This finding clearly illustrates that it is not possible to fully understand the effects of crime reduction initiatives without considering repeat victimisation as well as changes in the crime rate. Hence, the effect of the SDP was

not only to reduce crime in the SDP but also to reduce levels of revictimisation – which is one of the main aims of target hardening. In addition, the non-repeat victimisation rate within the non-targeted part of the SDP increased, possibly showing that offenders were trying out new targets in response to the interventions rather than returning to previously targeted properties.

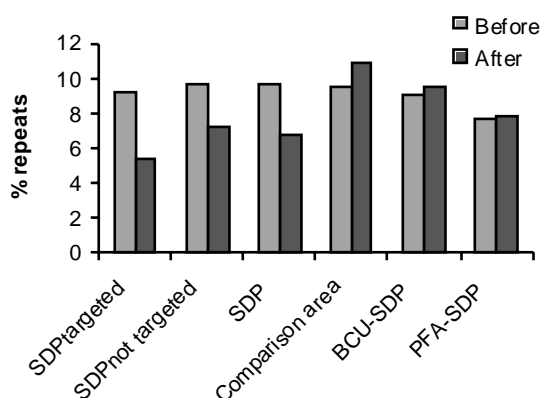


Figure 2 Proportion of burglaries that were incidents of repeat victimisation

Geographical displacement

To allow a detailed analysis to be conducted, we defined five (rather than one) concentric buffer rings that had the same morphology as the boundary of the scheme area. The first buffer was produced so that it started at the SDP boundary and finished 400 metres from the boundary at all points. This produces a band shape that mimics the SDP boundary all the way around. A further buffer was then created that began at the boundary of the first buffer and ended a further 400 metres from this boundary, meaning the outside boundary was 800 metres from the SDP boundary. Further buffers were created in the same way, until there were five rings surrounding the SDP area².

² The use of concentric rings is a convenient method of identifying buffers. However, there are problems with this approach, such as the inclusion of open land in the rings and the lack of attention to the potential direction of

To measure the extent to which displacement or diffusion of benefit occurred, we used a new technique, the Weighted Displacement Quotient (WDQ: Bowers & Johnson, 2002). Essentially, this examines the change in the distribution of crime in the buffer zone(s) and compares this with the previous distribution of crime and changes in the PFA - and then relates these patterns to any changes observed in the target area.

Considering Positive WDQ values indicate diffusion of benefit to the buffer zone and negative WDQ values indicate geographical displacement of crime. Considering the WDQ values, a figure of +1 indicates a diffusion of benefit where the burglary reduction in the buffer zone is equal to that in the project area. A figure of -1 indicates a displacement where the burglary reduction is entirely offset by increases in the buffer zone. A WDQ of zero represents a scenario where there was apparently no change in the buffer zone, or where this change could not be attributed to changes in the SDP. It is important to note that, for a variety of reasons, there is not necessarily a simple one-to-one relationship between the number of burglaries prevented and those displaced, and hence the WDQ values may exceed +/- 1.

Weighted Displacement Quotients, shown in Figure 3, were calculated for each of the five buffer rings. The results show that whilst there was, in general, evidence of geographical displacement there was also a diffusion of benefit in the buffer ring contiguous with the SDP boundary. The greatest evidence of displacement was observed for the second buffer ring, the effect then decreased in the subsequent rings, suggesting a possible distance decay effect.

displacement. For a fuller discussion of buffer zone definition, see Bowers and Johnson, 2002.

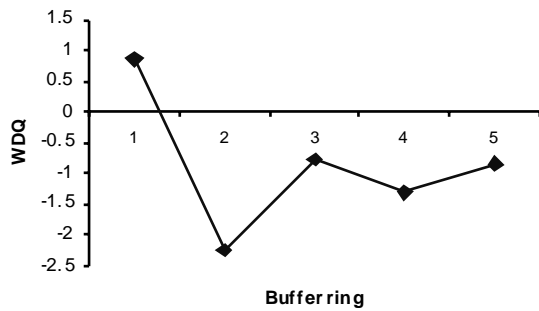


Figure 3 Weighted displacement quotients (WDQ) for the five buffer rings

Crime-switch displacement

A further type of displacement that crime prevention schemes may cause is crime switch displacement which occurs when offenders swap from undertaking burglary to committing other types of crime in an area. Rather than focusing on all types of crime, for the purposes of illustration, this section will consider the effects of SDP activity on four types of acquisitive crime, these being, 'theft from a person', 'theft of a car', 'theft from a car' and, the 'unauthorised taking of a car'.

Figure 4 shows the crime rates for the crime theft from car, for both the before and after SDP time periods. Consideration of the data for the four types of crime considered revealed that the SDP interventions appeared to have had a selective effect on the rates of other types of crime. Thus, whilst theft from a motor vehicle (Figure 4) showed a considerable increase relative to the change observed in the comparison areas, theft from a person actually decreased somewhat particularly relative to the BCU and PFA. Crime rates for the unauthorised taking of a vehicle and theft of car changed in a way that was generally consistent with the patterns observed for the three types of comparison area.

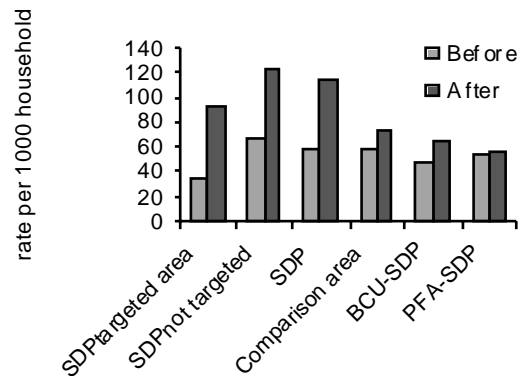


Figure 4 Theft from car rates before and after the SDP began

Notably, the change experienced within the SDP for theft from car was most apparent for the sub-area in which the interventions were concentrated. Such increases in other types of crime in the immediate and close vicinity of the intervention indicate that offenders who specialised in burglary in the area might well be switching to other types of crime in the same area, which is an obvious negative side effect of the scheme.

Measuring the effects of interventions

In addition to examining the extent to which the SDP had been effective, a technique was also developed for assessing the effectiveness of specific interventions. To illustrate, a simple analysis of the number of burglaries that occurred at target-hardened properties before and after the inception of the scheme revealed that more burglaries occurred after (62) than before the start of the scheme (55). However, such a simple analysis is misleading as it was not the case that all properties received target-hardening measures on the day the scheme began.

Thus, analyses were conducted to determine how many burglaries occurred after the actual date of target hardening. This revealed a different pattern of results, showing that 98 burglaries occurred at these properties before they were target-hardened and only 19 occurred following the intervention. Again, however, the analysis is confounded as the amount of time that would have elapsed

following target hardening may have been much shorter than that which elapsed prior to the intervention. For this reason, we produced 'opportunity dependent counts' which take into account the window of opportunity in which burglaries occur. These analyses confirmed that the intervention had been successful, with the risk to these properties before target hardening being 1.76 times that experienced after the intervention. In addition, using an extension to this methodology, it is also possible to quantify the outcome, in terms of the number of burglaries prevented by the intervention.

Conclusions

The use of disaggregate level crime data allows the examination of patterns of victimisation that simply cannot be studied using aggregate level information. New techniques for evaluating crime prevention schemes, along with some illustrations of these have been presented. These show the power of using disaggregate level data, and demonstrate that, in some cases, the wrong conclusions may be drawn where analyses are conducted using aggregate level data only.

The results of the analysis summarised above have a number of implications, as follows:

- It is important to consider the true boundaries and the real targets of crime prevention schemes. Using administrative boundaries for example that incorporate other areas and/or households as well as those receiving treatment will mask many of the real effects of treatment.
- To get a real picture of the effectiveness of a scheme it is important to consider other effects as well as the number of burglaries it has saved. In particular, it is important to gauge the extent to which the scheme causes displacement to other types of crime, other targets and other areas. It is entirely possible that any one scheme can have both positive and negative side effects in the form of diffusion of benefit and displacement. For

instance, for the Liverpool scheme there was a diffusion of benefit to targets nearby treated households and to areas located geographically closest to the targeted area. However, there was also evidence of displacement to other types of crime, such as theft from car and to areas located a little further away from the direct boundary of the scheme.

- Although crime prevention schemes ideally aim to avoid side effects such as displacement, understanding when and where they occur may ultimately lead to the development of more effective targeting strategies.

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Further details regarding the WDQ technique may be obtained from the authors, email: kjb@liverpool.ac.uk or S.D.Johnson@liverpool.ac.uk