The Geography of Bus Shelter Damage:
The Influence of Crime, Neighbourhood Characteristics and Land-Use

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Abstract

This paper offers unique insights into the distribution of damage to bus shelters, in a single case study area, Merseyside (UK). The geography of bus shelter damage is examined in relation to the criminogenic and socio-economic characteristics of its neighbourhood, and the local land use context. The findings suggest that shelter damage is related in a known and predictable way to known characteristics of its neighbourhood, and that shelters in areas with high levels of anti social behaviour and violence against the person are more susceptible to bus shelter damage. Two key factors in the occurrence of bus shelter damage appear to be lack of capable guardianships and the presence of youths. In relation to the influence of land use, the presence of parks, children's play areas and schools (particularly those whose unauthorised truancy levels were above the national average) were positively correlated with shelter damage. By contrast, negative relationships were found between shelter damage and the presence of pubs, clubs, and off-licenses. The implications of these findings for crime prevention are then discussed, alongside some potential avenues for future research.

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Introduction

Previous research has theorised that bus shelters are vulnerable to criminal damage and vandalism (Easteal and Wilson 1990). There have been some studies which examine crime at bus stops in general (Levine et al, 1986, Loukaitou-Sideris, 1999 and Liggett et al., 2003). However, to the authors' knowledge, few studies have focused specifically on bus shelter damage. This paper builds on some preliminary analysis of bus shelter damage (Newton, 2007), which demonstrated that damage is concentrated at particular shelters, and hinted that there is a relationship between shelter damage and certain neighbourhood characteristics. However, this earlier analysis used one year of shelter damage and examined older census data (1991), and bi-variate correlations were performed to examine the relationship between shelter damage and neighbourhood characteristics. This study examines three years of data as opposed to one year, and builds in regression analysis and land use data which were not included in the earlier paper.

This paper aims to scope the extent of the problem of bus shelter damage in the case study area of Merseyside, UK. Although mainly viewed as low level criminal behaviour it is important to examine this criminal damage for a number of reasons. Firstly, this type of crime is costly to service providers. It is estimated that the cost of this damage for repairs alone in 2003 on Merseyside was approximately £400,000 (Newton, 2004). Secondly it may add to feelings of insecurity amongst public transport users. Waiting at bus stop is an important component of the whole journey approach to public transport (DETR, 1999). The additional parts are walking to or from a stop, and travelling on a bus. However, if any part of the journey is perceived as unsafe then the whole journey may be replaced by a car trip or a decision might be made not to travel. Thus shelter damage may reduce passenger travel and increase feelings of insecurity. Furthermore, research by the then Department of the Environment, Transport and the Regions (DETR, 1998) suggest that reducing fear of crime and disorder on public transport journeys could increase patronage by 3% at peak and 10% at off peak times. Thirdly, shelter damage may add to feelings of insecurity in the area near to the shelter. Wilson and Kelling (1982) discuss the notion of broken windows and how minor signs of decay may suggest a lack of care and enforcement in the community, and Hough (1995) uses multivariate analysis of the British Crime survey to demonstrate that there is a direct link between disorder and levels of concern about crime.

Since focusing on bus shelters in particular is a novelty here, this research first aims to establish useful metrics in the definition of the extent of damage. It then examines the relationship between damage and other crime-related incidents, and identifies some factors of the local environment that may correlate with particularly problematic shelters. It then concludes by discussing the implications of the results for the prevention of bus shelter damage.

Before embarking on a description of the empirical analysis, it is useful to summarise some of the theoretical explanations concerning the possible cause of shelter damage to ascertain what might be the most likely motivations for this offence, who the likely perpetrators are, and, importantly, where such events may occur. The following sections therefore begin

with a definition of different types of criminal damage, and then move on to discuss possible perpetrators and concepts concerning the geographic pattern of the problem.

Defining criminal damage

If recorded by the police, bus shelter damage is likely to be classified as criminal damage (or 'vandalism' to use an alternative name). The 1971 Criminal Damage Act refers to an act of criminal damage being performed by "*...a person who without lawful excuse destroys or damages any property*", although in England and Wales vandalism is not a statutory offence. It has a range of classifications in the legal system ranging from "*criminal damage up to £20*" to "*criminal damage endangering life*" and "*arson*" (Barker and Bridgeman, 1994). It is estimated that 73% of vandalism is never reported to the police and that only 56% of that reported is officially recorded (Mayhew *et al*, 1993). Moreover, research by Newton (2007) suggested that in 2000 Merseytravel (the Passenger Transport Executive Group (PTEG) responsible for the provision of public transport in Merseyside) recorded 3116 incidents of damage to bus shelters. An analysis of police records found only 8 offences. For this reason it is unwise to rely on police data alone to scope the problem of criminal damage.

A further problem with using police data is that it is difficult to define vandalism by type. For example, a useful classification might concentrate on the targets (buildings, bus shelters, cars and so forth) this is hard to discern using police data. It is also difficult to distinguish between accidental and deliberate damage from these records.

A particularly useful classification of criminal damage was proposed by Cohen in 1973. This is based on the motivation of offenders to commit acts of vandalism. Wilson and Healey (1987) adapted this classification to distinguish between seven types of vandalism, which are:

- Acquisitive
  To acquire money or property, for example, breaking open telephone boxes
- Tactical
  The damage is a conscious tactic, a means to achieve some other end, such as breaking a window to be arrested and get a bed in prison
- Ideological
  Similar to tactical vandalism, but carried out to further an explicit ideological cause or to deliver a message, for example, chalking slogans on walls
- Vindictive
  Damage in order to obtain revenge, for example, breaking school windows to settle a grudge against the head teacher
- Play
  Damage in the context of a game; for example who can break the most windows of a house
- Malicious

An expression of rage or frustration which is often directed at symbolic middle class property. It is this type that has the vicious and apparently senseless facade which people find so difficult to understand

- Innocuous
  Damage done to property defined by youth as unimportant or of no value

Defining perpetrators

The classification above is also useful in providing insights concerning the type of offenders who may criminally damage bus shelters. In terms of bus shelter damage, acquisitive damage is unlikely as no financial gain can be met; play (in terms of damage occurring unplanned with a game) is unlikely due to the typical locations of shelters (on the edges of residential estates or on main roads) and vindictive is improbable as the shelter is effectively provided for the public and ownership is therefore difficult to define. Ideological and tactical damage are plausible but also less likely as there are other potential targets that may be more attractive for this (shops, cars, and large advertising boards, for example). Therefore the primary motives are likely to be malicious and innocuous damage. Research by Geason and Wilson (1990) suggests there are two particularly likely candidates for those who perform such of acts of vandalism on public transport and who, it can be inferred, are most likely to also commit criminal damage to bus shelters. These are:

(i) Children and Young Persons (aged 5-19)
(ii) Persons intoxicated with alcohol leaving pubs and clubs (where damage occurred because alcohol consumption was a contributory factor).

Geographic context

The literature therefore provides some clues as to who might undertake shelter damage and why. A further important question is that of where and when it is likely to occur. Routine activity theory suggests that for bus shelter damage to occur requires lack of capable guardianship, a suitable target, and a motivated offender, to converge in time and space (Cohen and Felson, 1979). In terms of a motivated offender this is complex phenomenon, and, as established earlier, the damage is likely to be for innocuous or malicious reasons. In terms of the location of the damage, crime pattern theory (e.g. Brantingham and Brantingham 1995) looks at the action (shelter damage or vandalism) that occurs within a specific situation at a particular location on a changing backcloth. How does this site, situation and backcloth vary between bus shelters, and are there characteristics common to shelters that are consistent with the occurrence of, or non occurrence of shelter damage? One possibility is that damage will occur in situations where there is low guardianship (in other words, where such acts are likely to go un-noticed). One might hypothesise that areas with large amounts of open space will be more at risk. In terms of land-use this could include areas near parks or play areas. A difficulty in examining when damage occurs is that it is, by its nature, often committed when there are few persons present, thus, it is likely

to be reported after the offence occurred, and this may be up to 72 hours after the damage was committed.

Another concept that may help to explain bus shelter damage is the idea of crime generators (Brantingham and Brantingham, 1995). Do some bus shelters act as crime generators, whereby (young) people congregate, and their presence encourages the unplanned occurrence of shelter damage? In other words, people might not go to bus stops with the sole motivation of committing criminal damage. A related question is whether damage is related to levels of use of the bus stop for legitimate purposes- or passenger flow.

Research that has focussed specifically on bus stop crime include Levine and Wachs (1986) and Wachs et al. (1986), who discuss how the influence of a shelter's location and patterns of shelter use can be studied to isolate factors that encourage or discourage crime at bus stops (all crime types). The findings highlight how crime at bus stops tends to be concentrated in high crime rate areas, and prescribe how prevention strategies can be targeted once high crime rate stops have been identified.

More recently work by Loukaitou-Sideris (1999), and extended upon by Liggett et al (2001), examines the connection between criminal activity at bus stops and environmental factors. The researchers found that crime at bus stops was correlated with an abundance of negative environmental factors within 300 feet of a bus stop. These included liquor stores, bars, vacant lots and buildings, and adult book stores. They concluded that the most important predictor of bus stop crime is location.

Other research has examined the relationship between crime and social and economic conditions more generally. Hirschfield et al. (1995) suggest that per capita risk of victimisation is higher within deprived areas. Additionally, further research has suggested that levels of crime in disadvantaged areas with high levels of social cohesion are significantly lower than expected and vice versa (Hirschfield and Bowers, 1997). Hence, one might expect criminal damage to be greatest in areas of high deprivation and low social cohesion. Here risk is examined in relation to bus shelters as opposed to victimisation of persons or properties.

Thus far, some possible characteristics of criminal damage to bus shelters have been established, in terms of who the perpetrators might be, what their motivations area and the type of locations which might have high concentrations of the problem. The remainder of this paper discusses these issues using empirical data from Merseyside, UK.

Data

Incidents of criminal damage to bus shelters were obtained from Merseytravel PTEG. This covered a three-year period of data from1st January 2000 to 31st December 2002. The fields recorded included a unique shelter reference number, the date an incident was reported (not necessarily the date on which the incident occurred) and the cost of the incident. Incidents included smashed glazing, graffiti or other types of vandalism, although the exact nature of

the criminal damage was not always specified. Each bus shelter was uniquely referenced with an X and Y co-ordinate to an accuracy of 1 metre. Stop type is also categorised to distinguish between concrete posts (simple stops), conventional displays (CDs) which are posts holding single glass or plastic panels displaying timetable information, and bus shelters.

Data from Merseytravel's annual passenger survey was also obtained, and this was available collated for clusters of bus stops (from 1 to 5 stops depending on their proximity). Using this data set, passenger volumes for each stop were calculated for a twelve-month period in 2000, based on the assumption that all the stops in each cluster receive an equal number of passengers. The information included an estimate of the number of passengers both boarding and alighting at each bus stop.

The data sets were imported into a Geographic Information System (GIS). Stop references were captured using their X and Y co-ordinates, as were incidents of shelter damage. The GIS intersect command was used to join bus stops to the Census Output Area (OA) in which they were situated. This enabled the cross-referencing of damage at each shelter with variables providing environmental information about the location of the stop. These include selected 2001 Census variables, the percentage open space in an OA and the percentage of built-up areas, recorded crime and command and control data. These variables were available aggregated to Census Output Area level. Individual land-use data from Ordnance Survey 1:1250 Landline data and records from a local information agency (Merseyside Information Service) were also collected, and these were available at individual level, geo-coded to an accuracy of 1 metre.

For the analysis that is described in the following sections, only OAs that contain at least one bus shelter were used. This is because OAs that did not contain bus shelters could not experience any shelter damage, since there was no opportunity for this type of crime to occur. Additionally, there some of the OAs in Merseyside were 2001 census restricted areas (no census data available), and these were also excluded from analysis. This resulted in a total of 1551 OAs that were used in the analyses. These contained a total of 2892 bus shelters. The results of a series of analyses examining the relationship between bus shelter damage and a number of selected variables will now be presented.

Volumes and Rates of Bus Shelter Damage

An important issue in gauging the extent of the shelter damage problem is how to express the level of risk to shelters in each area. A pure count of incidents of damage will indicate areas with high volumes of the problem, but these areas will not necessarily have high rates of the problem. This is comparable to examining the number of burglaries in an OA, but not accounting for the number of houses in each OA.

For this reason, Table 1 examines a number of possible denominators at OA level for the amount of shelter damage. These are estimates of the number of passengers per OA, the resident population of the OA, the number of households in each OA, and the number of shelters in each OA. The estimate for passengers in each OA is based on the annual passenger survey data provided by Merseytravel. The OA passenger volume rate is simply

the sum of the estimated shelter volume for each shelter in each OA (each shelter's estimate is based on an annual figure of boarders plus alighters). Hence these values represent passenger flows for an area (passengers getting on and off buses).

Table 1 shows correlations of the various possible denominators with the total volume of criminal damage to bus shelters at OA level. Some interesting trends are apparent. Passenger flow is positively correlated with shelter damage volume at significant levels and to a higher degree than the resident populations and number of households in each OA. This reflects a relationship between the movement of people through an area and the amount of shelter damage an area experiences. This fits in with the idea of accessibility creating criminal opportunities and producing crime generators.

Table 1 also shows that the number of incidents of bus shelter damage is most highly correlated with the rate of incidence of damage per shelter, followed by the rate of shelter damage per passenger (0.904, $p<.0001$ and 0.694, $p<0.001$ respectively). Although this is perhaps expected, it suggests the number of shelters in an OA is most likely to relate to the number of incidents of bus shelter damage, as is evident in the table. The residential population and number of households in each area, typically used to derive crime rates, are not indicative of the number of incidents of shelter damage. Hence the number of shelters in an OA is taken as an appropriate denominator for rate of bus shelter damage for subsequent analysis.

Table 1 Merseyside 2000 to 2002, Shelter Damage and Potential Denominators

Spearman's Rho (P value in parenthesis)	**Number of incidents of Shelter damage**
Volume of Passengers	0.344 ($p<0.001$)
Residential Population	0.190 ($p = 0.454$)
Number of households	-0.210 ($p = 0.403$)
Number of shelters	0.491 ($p <0.001$)
Shelter damage (rate per 100 shelters)	0.904 ($p<0.001$)
Shelter damage (rate per 100 passengers)	0.694 ($p<0.001$)

Bus Shelter Damage, Crime and Criminal Damage

Table 2 compares the rate of bus shelter damage per 100 shelters in each OA with police recorded crime and police command and control incident categories. This table reveals that at OA level there are statistically significant correlations between the number of incidents of bus shelter damage and particular crime types (using select police recorded crime categories), and also police command and control categories (all per 100 persons except burglary dwelling taken as per 100 households). Table 2 shows that the highest correlations with shelter damage are found with criminal damage and violence against the person offences, and for command and control calls for disorder and youths causing annoyance. This suggests that areas that experience relatively high rates of bus shelter damage also record high levels of certain types of crime. Hence, bus shelter damage generally occurs in high risk crime areas. It should be noted that violence against the person includes all Home

Office classifications under this code, including serious and non serious violence against the person. It was not possible using the data provided to separate this, but it is suggested this could be explored in the future.

Interestingly, the crime types that correlate most highly with bus shelter damage tend to be indicative of areas with a high level of anti-social behaviour (ASB), rather than more serious crimes such as burglary and robbery.

Table 2 Merseyside 2000 to 2002: Rate of Shelter Damage and Selected Crime Types

Spearman's Rho (P value in parenthesis)	Shelter damage (rate per 100 shelters)
All recorded crime	0.219 (p<0.001)
Criminal damage	0.326 (p<0.001)
Robbery	0.154 (p<0.001)
Burglary Dwelling	0.129 (p<0.001)
Violence against the person	0.289 (p<0.001)
Sexual crime	0.138 (p<0.001)
Theft/ Handling stolen goods	0.156 (p<0.001)
Theft from motor vehicle	0.140 (p<0.001)
Theft of motor vehicle	0.259 (p<0.001)
Drugs	0.217 (p<0.001)
Fraud	0.039 (p=0.121)
All command and control (C & C)	0.248 (p<0.001)
C & C Youths causing annoyance	0.335 (p<0.001)
C & C Disorder	0.316 (p<0.001)

Characteristics of High Volume Neighbourhoods

To examine links between shelter damage, crime and socio-economic conditions, 13 predictor variables were used in a multiple regression analysis in which the rate of shelter damage was the dependent variable. These variables were selected to represent the factors that were identified as being important in the literature (i.e. other crime types, deprivation, population age and housing density). The regression model used was the backward stepwise model, and all the required regression assumptions of the model were met.

Table 3 reveals that the 38% of the variance in bus shelter damage is explained by 8 of the 13 predictor variables. The F value represents the amount of confidence that can be placed in the model, and this is significant at the 99% confidence level ($p<0.01$). The Beta values (standardised coefficients) show the relative amount of influence each predictor variable has on the dependent variable (e.g. Brace et al, 2000). This suggests that of the eight predictor variables deemed influential by the model, youth's causing annoyance, percentage of 10-14 year olds, and percentage of open space are the variables with the most influence on bus shelter damage. The first two of these provide evidence of the importance of the presence of youths, and the latter measures hints at the significance of a lack of capable guardianship in the occurrence of bus shelter damage.

Table 3 Multiple Regression Analysis of Merseyside Shelter Damage 2000 to 2002 with Selected Socio-Economic Variables

R square=0.38, F=60.24, p<0.001 using the backward stepwise model.

Significant variables

Predictor Variable	Beta	p
Violence against person	0.31	<0.005
Theft of motor vehicle	0.24	<0.005
Youths causing annoyance (C+C calls)	0.52	<0.001
% open space	0.49	<0.001
% households rented local authority	0.44	<0.001
% 10-14 year olds	0.47	<0.001
% households EA parents unemployed	0.44	<0.001
% households no car	0.41	<0.001

Removed variables (not significant) are % 5-9 year olds, % 16-19 unemployed, criminal damage, % 16-24 year olds lone parents, and % households overcrowded.

The Influence of Local Land-Use

It is evident from the preceding section that a number of socio-economic, demographic and criminogenic characteristics of a neighbourhood may influence the extent to which criminal damage to bus shelters occurs. However, in addition to these influences, it is likely that a number of other factors may impact upon the amount of bus shelter damage. As mentioned in the introduction, prior research suggests the land use and physical infrastructure of the bus shelter environment may also influence levels of shelter damage experienced. This section therefore contemplates how land-use may influence bus shelter damage. Indeed, within a high risk or low risk output area, the risk to individual shelters will not be equal.

In order to consider the impact of land use a number of land use types were selected which, based on previous research (Liggett et al, 2003) were thought to influence levels of shelter damage. These included schools, off licenses, betting establishments, pubs and clubs, parks, and children's play areas. It was thought that the presence of these indicators would have an impact on the amount of bus shelter damage. For each bus shelter Euclidean distances between each identified feature and the bus shelter were calculated, for each land use type within a radius of 1000 meters of the bus shelter. From this an inverse distance weighting, and an exponential inverse distance weighting were produced, for each land use type, for each shelter, which could be seen to represent the amount of influence the land type use had upon the shelter. A distinct feature of the method is that land use types located closer to the bus shelter damage will heavily influence the magnitude of the measure. Thus, for each shelter, the inverse distance weighting was calculated by:

$$w = \frac{1}{} + \frac{1}{} + \frac{1}{} + \frac{1}{}$$

d_1 d_2 d_3 d_n

where w is the inverse distance weighting, and d_1 to d_n represent the distance from the bus shelter to each feature of the specific land use within the selected search radius. Hence shelters with lower values of *w* experience less influence from the land use than those with higher values of w. Exponential inverse distances (ew) were also calculated to produce a measure that gave extra weight still to the nearer land uses.

$$ew = \frac{1}{(exp)d_1} + \frac{1}{(exp)d_2} + \frac{1}{(exp)d_3} + \frac{1}{(exp)d_n}$$

Theoretically, both the number of land use types and distance to each feature or land use may influence the amount of damage a shelter experiences. This process was repeated for a further three search radius distances, capturing land uses within 500, 250, and 100 metres of the bus shelter respectively.

These inverse distance weightings (w) and inverse exponential distance weightings (ew) were then compared with the rate of bus shelter damage (per 100 shelters) using Spearman's Rank Order Correlation. The results of this analysis are shown in Table 4, and this presents a number of valuable insights into bus shelter damage.

Table 4 Inverse Distance Weightings: Merseyside Shelter Damage 2000 to 2002 Compared With Selected Land Use Types

	Search Radius (m)	Betting	Off Licenses	Pubs/ Clubs	Leisure Centres	Parks	Play Areas	Schools
N		340	479	1534	579	100	65	660
inverse (w)	1000	0.01	**-0.10**	**-0.19**	**-0.18**	0.10	0.06	0.03
	500	-0.01	**-0.10**	**-0.18**	**-0.13**	0.10	0.14	0.06
	250	**-0.05**	**-0.15**	**-0.19**	**-0.08**	**0.14**	**0.19**	**0.08**
	100	**-0.06**	**-0.22**	**-0.18**	**-0.05**	**0.16**	**0.20**	**0.08**
exp (ew)	1000	-0.02	**0.17**	**-0.22**	**-0.20**	0.13	0.02	**0.03**
	500	**-0.04**	**0.18**	**-0.21**	**-0.14**	**0.15**	**0.10**	**0.06**
	250	**-0.16**	**-0.19**	**-0.21**	**-0.08**	**0.19**	**0.16**	**0.08**
	100	**-0.16**	**-0.26**	**-0.22**	**-0.05**	**0.19**	**0.23**	**0.12**

For values in bold type, P<0.001

Table 4 shows the results of the use of the inverse and exponential distance weightings on the influence of a number of land use types on bus shelter damage. The first row, N represents the total number of each land use type feature across the entire area (Merseyside). Statistically significant relationships ($p<0.01$) are displayed in bold type. It was suggested in the introduction that certain 'negative' land use types (Loukaitou-Sideris, 1999) such as pubs, off licenses and betting establishments would encourage the occurrence of bus shelter damage, but this is not apparent. Indeed, negative relationships

were found between shelter damage and the presence of pubs and clubs, off licenses, betting establishments and leisure centres. In contrast, other land use types such as parks and children's play areas, did exhibit a positive correlation with levels of bus shelter damage.

There are a number of potential explanations for these findings. It is possible that the presence of off licenses and pubs and betting establishments serve as a form of capable guardianship or natural surveillance; the presence of people (a form of natural surveillance) deterring criminal damage to shelters. This also suggests that intoxicated patrons leaving these establishments do not tend to cause the damage. The positive correlation between shelter damage and parks and play areas (perhaps unsupervised and lacking guardianship between 1800 and 2159 when it is thought most damage occurs) also suggest lack of capable guardianship may be a key factor in promoting levels of bus shelter damage.

Interestingly, there was a slight positive correlation found between schools and shelter damage but this value was only 0.08, a very small correlation. To investigate this further, the schools were divided into type A and type B. Type A schools were those whose unauthorised truancy levels were greater than the national average, and at type B schools unauthorised truancy rates were less than or equal to the national average, based on the school performance tables[3]. From this repeated analysis, for which results are shown in Table 5, it is evident that the presence of type A schools (higher truancy levels than the national average) displayed a positive correlation with bus shelter damage (0.31, P<0.01 for 100m search radius) and type B schools (equal or lower rate of truancy levels than national average) displayed a very small negative correlation with bus shelter damage (-0.05, p<0.01).

Table 5 Inverse Distance Weightings: Merseyside Shelter Damage 2000 to 2002 Compared With School Types

	Schools	Schools A	Schools B
N	660	147	513
inverse(w)	0.03	**0.15**	-0.01
	0.06	**0.21**	-0.01
	0.08	**0.24**	**-0.03**
	0.08	**0.31**	**-0.05**
exp(ew)	**0.03**	0.05	-0.01
	0.06	0.07	**-0.05**
	0.08	**0.11**	**-0.13**
	0.12	**0.15**	**-0.15**

For values in bold type, P<0.001

It is therefore evident that some schools are correlated positively with shelter damage, which suggests young children or youths may be responsible for the damage. Indeed distinguishing between schools above and below the national truancy rate, suggested that

[3] These values are available online at http://www.dfes.gov.uk/performancetables/.

damage was more likely to occur around schools with higher levels of truancy, adding more weight to the possibility that school children are sometimes responsible.

A final observation that should be made relates to the various modelling methods that have been used. Both inverse distance and exponential inverse distance weightings have been used to explain the influence of land use on shelter damage. The latter of these measures adds more weight to those land use features that are nearer to the item of interest (shelter damage in this instance), and it is suggested from these results that this is a more appropriate model due to the greater significance values that are evident. It is also evident that the models that only use land use in the 100 metres surrounding the bus shelter are generally more significant. This demonstrates the particular influence of nearby land-uses.

Conclusions

In this paper a number of empirical methods have been used to examine one particular crime type, criminal damage to bus shelters.

It was found that the rate of bus shelter damage was positively correlated with a number of crime types, which tended to be those indicating high levels of ASB, rather than more serious offences. Further to this, analysis suggested a positive relationship between bus shelter damage and certain social conditions such as levels of deprivation and others. This adds weight to the hypothesis that there is a clear social gradient in the degree to which neighbourhoods are prone to shelter damage.

Evidence was found of a negative relationship between the presence of pubs, off licenses and betting shops and shelter damage. Parks and children's play areas, thought to be less supervised in the evening, are positively correlated with shelter damage. This suggests the possibility that criminal damage of bus shelters is less likely to be an alcohol-related crime (in terms of intoxicated adults leaving pubs and clubs), and a better explanation might be the presence of youths (who may or may not be intoxicated but are probably under the legal drinking age). By examining the influence of schools it was found that their impact was selective; schools with high truancy levels were positively correlated with shelter damage, and schools with low truancy levels were slightly negatively correlated. Hence, it is perhaps not only the presence of a particular land use feature, but also the characteristics of the individuals who use that facility that should be considered.

There was also some evidence to suggest that bus shelters act as crime generators for bus shelter damage. Bus shelters are an area where persons congregate, but for different reasons and at different times of the day. On the one hand, the evidence appears to suggest that shelter damage occurs when there is lack of capable guardianship, as nearby open space is an indicator of crime. On the other hand, high volumes of damage occur where passenger flow is high. This suggests a complex interaction between levels and types of use of shelters at different times of the day.

It is important here to consider the different interactions of crime with characteristics of the micro level (individual bus shelter), meso level (OA) and macro level (Merseyside)

(Taylor, 1997). This research examined shelter damage at both the meso level (in relation to output areas), and micro level (in relation to land use). It is important to note that the level of risk to each individual shelter in a low or high risk OA will vary (there will be heterogeneity within OAs). It is likely that, in addition to the neighbourhood and land use characteristics of a shelter, visibility, lighting and other micro environmental influences could play a part in bus shelter damage. This will have implications for targeting prevention resources (at high risk areas and/or at high risk shelters). It is suggested as more detailed data becomes available at the micro level, that this is incorporated into future analysis.

This paper provides evidence for criminal damage to bus shelters, and suggests that lack of visibility or guardianship, a high passenger flow, the presence of youths, or open space (away from houses) might all be contributory factors in the occurrence of such vandalism. A question that is evident here is how much the influencing factors of shelter damage may also be present in vandalism to other public service facilities, particularly those in unsupervised or open public spaces. Research by Mawby (1977) for example examined vandalism to telephone kiosks, again using data provided by service agency as opposed to police records. This found, among other results, that there was a direct relationship between kiosk use and the number of incidents of vandalism. This mirrors the results in the current research that high levels of damage occur where passenger follow is high.

It is possible the motivations for other "street furniture" damage may be similar, although care should be taken to distinguish for example, theft of money from a kiosk from vandalism of a telephone kiosk. Are their similar risk characteristics between criminal damage to bus shelters, telephone kiosks, and other public service facilities? It seems likely that there are.

Some weight to this argument is provided by Williams (2004) who builds on work by Sutton (1987). They discuss the idea of Peer Status Motivated Vandalism (PSMV), whereby the act is motivated by a youth's desire to impress or gain status amongst peers. This sub-type of criminal damage tends to be committed in groups and not by offenders working in isolation. Bus shelter damage often appears to occur as a result of a large group of youth's congregating at a bus shelter, as opposed to intoxicated persons passing by a shelter on their way home. The idea of crime attractors and crime generators (Brantingham and Brantingham 1995 are relevant here, raising two plausible explanations. The first is that damage may be pre-planned by a group of youths (a crime attractor), the second that it occurs as a bi-product of the youths congregating at a shelter. Both of these may occur due to PSMV. Further research into this area is clearly warranted.

Recommendations for Implementing Prevention Measures

There are a number of examples in the literature of attempts to reduce and tackle problems of bus shelter damage. These approaches range across a spectrum of techniques ranging from social prevention to situational prevention and crime prevention through environmental design (Clark, 1997 and 2002), and examples include:

Social prevention
: Education and anti-vandalism publicity, diversion projects and alternative activities for youths (legal outlets for graffiti or youth activity groups), youth action groups, adopt-a shelter, community ownership

Criminal justice programs
: Strict detection, arrest and sentencing

Target hardening
: More vandal and graffiti resistant materials used in shelter design, making it harder for youths to obtain spray paints, making spray paints easier to clean and remove

Increased Surveillance
: CCTV, increased staff presence, increased security presence and patrols

Effective Management
: Foster sense of community ownership, rapid identification removal and cleaning of problem, good data and information, sharing of information with other agencies involved, dissemination of failed and good practice.

Planning and Design
: Design and planning of environment and shelters to reduce damage and vandalism, design aesthetically pleasing shelters that are more difficult to damage

Good overviews, with example case studies of these methods, can be found in Easteal and Wilson (1991), Wilson and Healey (1987), Barker and Bridgeman (1994), Sherman et al (1997), DTLR (2002). The overall consensus of these authors is that the more effective measures tended to combine a range of approaches and use a multi-agency based solution. Furthermore, many of the schemes lacked any evaluation at all, and there were only a small number of rigorous systematic evaluations. Hence, although the practitioner is faced with an extensive choice of measures, there is limited guidance available as to the effectiveness of a particular measure, nor the mechanisms behind its success or failure.

More generally, in previous research on preventing vandalism and abuse of street furniture, a number of different types of strategy have been suggested. In his research on telephone kiosks, Mawby (1977) suggested using re-enforced glass and placing kiosks in more visible space. Decker (1972) found that fitting parking meters with a 'slug-rejection device' stopped people from evading parking charges and even caused a dip in the problem nearby in old style meters. Hence, situational techniques can prove effective. Hirschfield and Bowers (1998) advocated another approach in reducing hoax calls to the fire brigade made from public telephone boxes. They found that the problem was very concentrated; 2% of the call phones accounted for 20% of the incidents. Hence, they suggested a publicity campaign pointing out the serious consequences of such calls in the most high risk boxes. This suggests that a range of measures may be applied but they need to be crime specific. Thus, for shelter damage, reinforced or toughened glass (such as poly-carbonate glass) may be appropriate. However this is susceptible to other forms as damage such as burning and smearing of the polycarbonate material by cigarette lighters. Perhaps the design of the shelters should be considered, or their location moved slightly. The glass is important for visibility and for protecting the passenger from adverse weather conditions. Perhaps an alternative solution can be sought without the use of glass that still maintains good visibility and protects the user from adverse weather.

There are as number of recommendations for crime prevention that can be stated on the basis of the findings of this particular research. As certain neighbourhood characteristics have been shown to promote shelter damage, shelters identified in areas with these characteristics should be prioritised. Furthermore, research by Newton (2004) found that a small proportion of shelters experience a larger percentage of damage. By first targeting the high risk shelters that are in the high risk areas initial positive reductions may be found.

Two key factors in the occurrence of shelter damage highlighted by the findings of this research are the presence of youths and lack of capable guardianship. It is advisable that social and education programs should be implemented (perhaps combined with other agencies attempting youth diversion schemes) in areas with high shelter damage. Perhaps this should also be targeted in areas with high risk shelters that are also high risk areas for shelter damage.

The findings also suggest prevention should focus on the particular environment and land-use of the shelter. For example, re-enforced shelters could be used near schools; but this cost may not be necessary elsewhere. Where open space is nearby, it could be advisable to move the shelter to a location with greater natural surveillance.

Finally, it is essential to evaluate the impact of any crime prevention initiatives to reduce bus shelter damage more fully, to explore the likely reasons why such schemes have been a success or failure, and the mechanisms behind this.

Recommendations for further research

This research has presented a number of important findings in relation to the location of bus shelter damage. However, this also raises some important future research questions. Firstly, it would be useful to know whether the geographic patterns of shelter damage vary in relation to time of day and month/season. Although shelter damage from the PTEG can not be separated by time of day, it is possible to split recorded crime and calls for service data by time of day and month or season to examine whether different relationships exist.

There is also a need to add additional micro level data on land use and the physical infrastructure of areas as this becomes more available, in order to examine its influence on shelter damage in more detail. As indicated above, variables such as lighting levels and visibility, and the level of natural surveillance would be useful here. In terms of the latter, an analysis which was able to define the lines of sight from a particular shelter, using a method such as the space syntax approach (Hillier and Shu 1998) would be one possibility.

In the analysis above, the overall incidence rate of shelter damage has been examined, without looking in much detail at the concentration of victimisation on certain individual shelters. Further research could examine the extent of repeat victimisation (e.g. Pease 1998) and consider whether shelters that are victimised are likely to be victimised again in the near future. Furthermore, research could be used to establish whether an initial victimisation increases the risk of damage to nearby shelters for a period of time (near

repeat victimisation; see for example Bowers and Johnson 2005, Townsley et al 2003). Finding such time dependent victimisation would have clear implications for policy.

An obvious question for further research is whether these research findings are unique to the case study area, or whether similar patterns and relationships are evident elsewhere. This has implications for transferring successful crime prevention schemes to areas with different socio-economic and physical characteristics. Finally, an alternative method that could be used to examine the phenomenon would be to interview offenders of bus shelter damage, to ascertain the motivations behind their actions. However, this would potentially be time consuming and costly and subject to bias if it relied solely on detected offenders.

References

Barker, M. and Bridgeman, C. (1994), Preventing Vandalism: What Works? *Police Research Group Crime Detection and Prevention Series*: Paper 56. London: Home Office.

Bowers, K.J., and Johnson, S.D. (2005). Domestic burglary repeats and space-time clusters: the dimensions of risk. *European Journal of Criminology*, 2(1), 67-92.

Brace, N., Kemp, P. and Snelgar, R. (2000), *SPSS for Psychologists: A Guide to Data Analysis Using SPSS for Windows*. London: Palgrave Macmillan.

Brantigham, P. and Brantingham, P. (1995), Criminality of Place: Crime Generators and Crime Attractors. *European Journal on Criminal Policy and* Research, 3(3), 5-26.

Clarke, R. (1997), (Ed), *Situational Crime Prevention*: *Successful Case Studies*. Second Edition, New York: Harrow and Heston.

Clarke, R. (2002) *The Theory of Crime Prevention through Environmental Design* [online] http://www.edoca.net/Resources/Articles/Clarke_the_theory_of_crime_prevention_through_environmental_design.pdf [accessed 15/07/2007].

Cohen, L. and Felson, M. (1979), Social Change and Crime Rate Trends: A Routine Activity Approach. *American Sociological Review* 44, 588-608.

Decker, J. F. (1972), Curbside Deterrence: An analysis of the Effect of a Slug Rejection Device, Coin View Window and Warning Labels on Slug Usage in New York City Parking Meters, Criminology 10(1):127–42

Department of the Environment, Transport and the Regions (DETR), (1998), *A New Deal for Transport: Better for Everyone*. London. DETR.

Department of the Environment, Transport and the Regions, (DETR), (1999), *Personal Security Issues in Pedestrian Journeys*. London. DETR.

Department for Transport, Local Government and the Regions (DTLR), (2002), *Get on Board: An Agenda for Improving Personal Security in Bus Travel*. London: DTLR.

Easteal, P. and Wilson, P. (1991), *Preventing Crime on Transport*. Canberra: Australian Institute of Criminology.

Geason, S. and Wilson, P. (1990), *Preventing Graffiti and Vandalism*. Canberra: Australian Institute of Criminology.

Hillier, B. and Shu, S. (1998) Crime and urban layout: The need for evidence. Easingwold: Home Office Crime Prevention College.

Hirschfield, A, Bowers, K. and Brown, P., (1995), Exploring Relationships between Crime and Disadvantage on Merseyside. *European Journal of Criminal Policy and Research*, 3 (3), pp 93-112.

Hirschfield, A, and Bowers, K., (1997) The Effect of Social Cohesion on Levels of Recorded Crime in Disadvantaged Areas. *Urban Studies*, 34 (8), 1275 – 1295.

Hirschfield A.F.G. and Bowers, K.J. (1998): Monitoring, Measuring and Mapping Community Safety in A.Marlow and J.Pitt (eds) *Planning Safer Communities*, Lyme Regis: Russell House Publishing, *p*.189-212.

Hough, M. (1995) Anxiety about Crime: Findings from the 1994 British Crime Survey. *Home Office Research Study 147*. London: Home Office.

Levine, N., Wachs, W., and Shirazi, E. (1986), Crime at Bus Stops: A Study of Environmental Factors. *Journal of Architectural and Planning Research*, 3 (4), 339-361.

Loukaitou-Sideris, A. (1999), Hot Spots of Bus Stop Crime: The Importance of Environmental Attributes. *Journal of the American Planning Association*, 65 (4), 395-411.

Liggett, R. Loukaitou-Sideres, A., and Iseki, H. (2001), Bus Stop-Environment Connection: Do Characteristics of the Built Environment Correlate with Bus Stop Crime? *Transportation Research Record*, No. 1760, pp 20-27.

Mawby, R.I. 1977, 'Kiosk Vandalism: A Sheffield Study', *British Journal of Criminology*, vol. 17, pp. 30-46.

Mayhew, P., Aye-Maung, N. and Mirrlees-Black, C. (1993), The 1992 British Crime Survey. *Home Office Research Study 132*, London: HMSO.

Newton, A. (2004), *Utilising GIS and Crime Place Principles to Examine the Nature and Extent to Crime and Disorder on Public Transport*. Unpublished PhD Thesis: The University of Liverpool, UK.

Newton, A. (2007), Routing out the Hot Spots: Applying GIS and Crime Place Principles to Examine Crime and Disorder on Public Transport. In Wise, S. and Kraglia, M. (Eds), *GIS and Evidence Based Policy Making*. London: Taylor and Francis, pp-69-93. *In press*.

Pease, K. (1998). Repeat victimisation: Taking stock. *Crime detection and Prevention Series, Paper 90*. Home Office: London

Sherman, L., Gottfredson, D., MacKenzie, D., Eck, J., Reuter,P. and Bushway, S. (Eds), (1997), *Preventing Crime*: *What Works, What Doesn't, What's Promising*. [Online] http://www.ncjrs.gov/works/ [accessed 13/08/2007].

Sutton (1987) Differential Rates of Vandalism in a New Town: Towards a Theory of

Relative Place, *Unpublished PhD Thesis*: Lancaster.

Taylor, R. (1997), Crime and Small-Scale Places: What We Know, What We Can Prevent, and What Else We Need to Know, in Travis, J (Ed), *Crime and Place*: *Plenary Papers of the 1997 Conference on Criminal Justice Research and Evaluation*. Washington DC: National Institute of Justice.

Townsley, M, Homel, R. and Chaseling, J. (2003) Infectious Burglaries: A Test of the Near Repeat Hypothesis. *British Journal of Criminology*, 43, 615-633

Willaims, M. (2004), Understanding King Punisher and His Order: Vandalism in an Online Community - Motives, Meanings and Possible Solutions, *Internet Journal of Criminology* [Online] http://www.internetjournalofcriminology.com/Williams%20-%20Understanding%20King%20Punisher%20and%20his%20Order.pdf [accessed 5/10/2007].

Wilson, P. and Healy, P. (1987), *Graffiti and Vandalism in Transportation Systems*. Trends and Issues No. 6. Canberra: Australian Institute of Criminology.

Wilson, J and Kelling, G. (1982), Broken Windows. *The Atlantic Monthly*, 249 (3) 29-38.