

Title: A study of bus route crime risk in urban areas. The changing environs of a bus journey.

Author: Andrew Newton

## ABSTRACT

This study attempts to examine the risk of bus route crime and how it is influenced by environmental characteristics along the bus corridor. These include changing levels of crime risk, socio-economic influences, and changes to the physical infrastructure including land use. Three urban case study areas in the UK are used. The findings suggest that the risk of bus crime along a journey is influenced by overall levels of crime (for specific categories of crime only), that the level of risk increases in high crime areas, and that risk is raised further when there are more stops along that route. Prevention implications of these findings are discussed, and avenues for future research are presented.

## INTRODUCTION

Public transport has an important role to play in reducing social exclusion (for mobility and access to work, leisure and other activities), and has obvious environmental benefits in reducing the pressure of car and other non public transport journeys. Recent studies have demonstrated that after reliability, concerns for personal security are the second highest limiting factor in public transport usage and reducing such fears may significantly increase patronage on buses (the then Department for Transport, Environment and the Regions (DETR), 1998 and Baker and Bewick, 2001).

There have been a number of studies that examine crime and disorder on public transport and potential crime prevention solutions. For example, Felson et al (1996) examined crime risk at the port authority bus terminal in New York, and the Department for Transport (DfT) has published guidance on best practice for bus stations in England and Wales (DfT, 2004). A number of studies have focussed on crime near bus stops (Loukaitou-Sideris 1999, Liggett et al., 2001, Newton and Bowers 2007, and Newton 2007). Studies have also focused on crime inside and near to railway stations (Block and Davis, 1996, and DfT (2006), and along railway lines (Gaylord and Galliher, 1991). Robinson (1998) examined the potential crime impact to an area where a proposed new station was to be added to the Skyrail in Vancouver. More detailed overviews of public transport crime are provided by Eastel and Wilson (1991), Clarke (1996), Smith and Clarke (2000) and Smith and Cornish (2006).

It is important to consider the public transport journey as a whole (DETR, 1999) including travelling to or from a stop or station, waiting at a stop or station, and travelling en-route. Any incidents that occur at any point of the journey may affect future decisions to travel by public transport. Most studies to date have predominantly focussed on crime prevention activities at stops and stations (the access or entry and exit points to the transport system). There is limited research examining risk during the walking part of the

journey (to or from a station stop), or crime risk whilst travelling on a moving vehicle (on a bus, train or tram for example). Although some studies have crime risk along railway routes (Smith and Cornish, 2006) little is known about crime risk along bus routes. This study aims to examine crime events on bus routes and how this relates to the environs through which a bus traverses.

The occurrence of crime events has been shown not to be random and a number of environmental criminological theories provide useful insight into potential reasons for this. Routine activities theory (Cohen and Felson, 1979) emphasises how the juxtaposition of offenders, suitable targets, and lack of guardianship are likely to result in the occurrence of a crime event. Crime pattern theory (Brantingham and Brantingham, 1993) suggests that crimes will cluster around nodes (the places where people travel to and from), along pathways (the paths along which people travel to get to different nodes) and at the boundaries to both nodes and pathways (edges). A third important theory is of crime attractors and crime generators (Brantingham and Brantingham, 1995). A crime generator is a feature that attracts large numbers of people for reasons other than to commit a crime, yet at particular times and places this concentration of victims and offenders produces a crime opportunity. Crime attractors are places that offenders visit due to knowledge of the area's criminal opportunities, as they expect an opportunity to commit a criminal act. Both of these may apply to public transport systems, for different crime types and at different times of the day. All these theories suggest that opportunity plays a major role in the occurrence of crime and disorder on public transport

Opportunity, crime patterns and routine activities are all influenced by a range of environmental characteristics including the socio-demographic make-up of an area, the physical infrastructure and land use, and these will also vary temporally (for example, by time of day, day of week and month of year). Along transport corridors this environment may change rapidly. At each stop there may be a new set of environmental characteristics which may all influence crime risk. These stops could be described as a series of inputs and outputs to the bus system. However, few studies have attempted to assess how crime risk changes during the course of a bus journey. Furthermore, along routes there are additional risks, for example objects projected at moving vehicles or obstacles left to obstruct routes. Both of these potentially present major risks as they may result in severe injuries or even loss of lives, especially if over fifty persons are travelling on full bus.

This study focuses on bus route crimes and investigates how environmental characteristics (including crime risk, but also physical and socio-economic features) may influence bus crime during a bus journey. In doing so it builds upon previous research on the spatial and temporal concentration of crime on public transport (Pearlstein and Wachs (1982, Levine, Wachs and Shirazi (1986).

There are perhaps two main reasons why there has been a paucity of research in this area. These are the availability of suitable data, and the application of relevant methodological techniques. This is discussed in detail by Newton (2004). In England and Wales, bus routes are not routinely policed (outside of London), and there is no Home Office crime classification for bus crime. In addition, the regulator for bus operators varies by area

(Transport for London, the Passenger Transport Executives (PTEs) in six major metropolitan areas, and Local Authorities elsewhere), and a number of operators provide bus services in each area. Thus, there is no consistent or standardised mechanism for recording bus crime incidents. Furthermore, problems exist in accurately locating the position of a crime event when it occurs on a moving bus. Moreover, analysis of crime events has centred upon discrete locations (for example the location of a house or point-pattern analysis) or analysis of administrative units (for example crime within police beats or census wards) (Hirschfield and Bowers, 2001, Chainey and Ratcliffe, 2005). Few studies have examined linear patterns of crime, except perhaps for those examining an offenders' journey to or from a crime. This research is innovative in that it attempts to examine linear patterns of crime, and the relationship between a linear route (a bus corridor) and the changing external environment it traverses.

## THE RESEARCH QUESTIONS

. The principal research questions in this study are:

- To examine whether or not (and if so which) characteristics of the physical, socio-economic, demographic and criminogenic environment promote or discourage crime and disorder on buses;
- To examine the relationship between 'bus crime' and 'other crimes', based on the location of bus crime offences;
- To profile crime risk along bus routes and to examine whether risk is heightened in areas with high levels of 'other crimes', and;
- To investigate how the risk profile changes along the bus route and how this relates to changing criminogenic characteristics traversed en-route.

## THE CASE STUDY AREAS

At the beginning of this research questionnaires were sent to transport providers and regulators in the United Kingdom to assess the nature and the extent of the bus crime and disorder data that they recorded, in order to identify areas which held data suitable for this analysis. A description of the data required for this project is outlined in the next section of this paper. Only three case study areas were identified that collected and were willing to provide data suitable for the purposes of this research. These were South Yorkshire, Merseyside, and London.

South Yorkshire is a metropolitan county situated in the central northern England, and its main urban areas are Sheffield, Barnsley, Doncaster and Rotherham. Public transport in the County is regulated by the South Yorkshire Passenger Transport Executive (SYPTE). In 2003 the population of South Yorkshire was approximately 1.27 million persons and there were an estimated 125 million bus passenger journeys made during 2003.

Merseyside is a metropolitan county situated in the north west of England, with a population in 2003 of approximately 1.3 million persons. Merseytravel is the PTE

responsible for the regulation of public transport in the area. It is estimated annually that approximately 170 million passenger bus journeys were made on Merseyside in 2003.

London is the capital with the most extensive built up area in the country, and in 2003 its population was estimated at 7.5 million. In London, Transport for London (TfL) is the regulatory body responsible for public transport. This is unique for buses as, unlike the rest of England, London buses were not subjected to deregulation and privatisation in 1986. There were approximately 1534 million bus passenger journeys made in London during the financial year 2002/2003. The bus crime data for this project were supplied by TOCU (the Transport Operational Command Unit). This is a joint control room between TfL and the Metropolitan Police Service (MPS), and this is unique to the United Kingdom as it provides the only dedicated police service for buses. In 2003 this operated on along 20 bus corridors (26 bus routes) in Greater London. These are subdivided into central London, and South East, South West, North East and North West areas.

## DATA

A number of sources of data were required to answer the research questions posed by this study. The three key features that required data for this research are the public transport environs, bus crime and disorder, and 'other' crime. These data were captured from a variety of sources, and the exact nature of the data also varied by each case study area. Data were requested for a minimum period of twelve months. It was necessary for the data provided within each study case area to represent equivalent time periods. Table 1 below provides an overview of the data obtained for each of the three case study areas. It is important to state that the data available influenced the analytical techniques used to answer the research questions.

For the purposes of this research bus crime and disorder is defined as any incident of crime or disorder that occurs on the bus network, and includes bus infrastructure, passengers and staff. 'Other' crime and disorder refers to incidents that are recorded by the police outside of the public transport environment that are thought may be related to bus crime. These were selected on the basis of previous research (Newton et al, 2004) and are detailed in the subsequent sections of this report. There are also published limitations of using police recorded crime including levels of under-reporting (Simmons and Dodd, 2003) and inaccuracies in the reporting of the location of crimes (Ratcliffe, 2004). However, these data are used as they provide the most representative indicator of overall levels of crime risk in an area a bus traverses. There are also limitations of using disorder data from calls for service (999 calls). This may be subject to over-reporting (multiple reports of a single disorder incident) and also may suffer from inaccurate reporting of its location. However, such data do provide a good indicator of levels of disorder in an area through which a bus traverses, and also is often used as a measure of the public's demand for police service in an area (Hirschfield and Bowers, 2001). Levels of under-reporting of bus crime are unknown, and no large scale surveys have been undertaken to estimate risk (unlike the British Crime Survey which is used to estimate under-reporting of police recorded crimes in the UK). However, a study in Los Angeles

(Levine and Wachs, 1986) suggested bus crime incidents may be under-reported by approximately twenty to thirty fold.

Table 1: Description of data obtained for each case study area

Data	Area		
	South Yorkshire	Merseyside	London
Transport and other environmental data	<ul style="list-style-type: none"> <li>• Digital bus network (including stops and route locations) supplied by SYPTE</li> <li>• Census 2001 (academic license)</li> </ul>	<ul style="list-style-type: none"> <li>• Digital bus network (including stops and route locations and route frequencies) supplied by Merseytravel</li> <li>• Census 2001 (academic license)</li> <li>• Superprofile Lifestyle (academic license)</li> <li>• Index of Local Conditions (ILC) and 'Built Area' supplied by Merseyside Information Services (MIS)</li> </ul>	<ul style="list-style-type: none"> <li>• Digital bus network provided by TOCU/TfL for four selected corridors</li> </ul>
Bus crime and disorder data	<ul style="list-style-type: none"> <li>• Supplied by SYPTE from SAFE recording system</li> <li>• Unique reference number, time, date, location, crime type, incident description, estimated cost (where available) requested</li> <li>• Location reported by nearest bus stop, no route information</li> <li>• SYPTE use their own bus crime type classification code</li> </ul>	<ul style="list-style-type: none"> <li>• Supplied by Merseytravel from Travelsafe system</li> <li>• Unique reference number, time, date, location, crime type, incident description, estimated cost (where available) requested</li> <li>• Location reported by route number only, no additional information of where along route</li> <li>• Merseytravel use their own bus crime type classification code</li> </ul>	<ul style="list-style-type: none"> <li>• Supplied by TOCU/TfL for four corridors</li> <li>• Unique reference number, time, date, location, crime type, incident description, estimated cost (where available) requested</li> <li>• Location reported by 250m grid reference</li> <li>• TOCU own bus crime type classification code</li> </ul>
'Other' crime and disorder data	<ul style="list-style-type: none"> <li>• Supplied by South Yorkshire Police</li> <li>• For crime data a unique crime/incident number, location, Home Office classification code, date, time and MO requested</li> <li>• HO codes requested were assault, burglary, criminal damage, drugs, fraud, homicide and related crimes, robbery,</li> </ul>	<ul style="list-style-type: none"> <li>• Supplied by Merseyside Police</li> <li>• For crime data a unique crime/incident number, location, Home Office classification code, date, time and MO requested</li> <li>• HO codes requested were assault, burglary, criminal</li> </ul>	<ul style="list-style-type: none"> <li>• Supplied by Metropolitan Police</li> <li>• For crime data a unique crime/incident number, location, Home Office classification code, date, time and MO requested</li> <li>• HO codes provided were assault, actual bodily harm, affray, criminal damage, drugs, firearms, possession of offensive</li> </ul>

	<p>theft and handling, theft of/from motor vehicles, and wounding.</p> <ul style="list-style-type: none"> <li>• For disorder data requested from 999 calls as above but categories requested were breach of the peace, disorder, criminal damage, disorder, drunkenness, noise nuisance, suspicious behaviour, theft, violence against the person, and youth nuisance)</li> <li>• Location recorded by 12 figure grid reference (1metre accuracy)</li> </ul>	<p>damage, drugs, fraud, homicide and related crimes, robbery, theft and handling, theft of/from motor vehicles, and wounding.</p> <ul style="list-style-type: none"> <li>• For disorder data requested from 999 calls as above but categories requested were disorder and youth disorder</li> <li>• Location recorded by 12 figure grid reference (1metre accuracy)</li> </ul>	<p>weapons, forgery, theft of and theft from vehicle, theft from person, threatening/abusive/insulting behaviour, and violent disorder</p> <ul style="list-style-type: none"> <li>• No additional disorder codes obtained</li> <li>• Location reported by 250m grid square reference</li> <li>• Data supplied for four TOCU corridors</li> </ul>
Time period	1 <sup>st</sup> Oct 2002 to 31 <sup>st</sup> September 2003 (12 months)	1 <sup>st</sup> January 2002 to 31 <sup>st</sup> December 2003 (2 years)	1 <sup>st</sup> January 2003 to 31 <sup>st</sup> December 2003 (12 months)

## METHODOLOGY

All the data supplied for this research was captured into a GIS software package (ArcView 3.2) for each case study area. All areas provided information on the bus network, bus crime and other crime. For Merseyside, additional data were obtained on route frequencies, on socio-economic characteristics (the Index of Local Conditions, and the Superprofile Lifestyle geo-demographic classification) and on land use (built area coverage). A description of the neighbourhood types that comprise Super Profiles is given in the Appendix. For more information on geo-demographics and SuperProfile Lifestyle see Brown (1991) and Brown and Batey (1994). There were some differences in the data obtained by study area. These are now highlighted as they had implications on what analytical techniques could be employed.

### Bus route crime

With an idealised data set, with data on the locations of bus crime and disorder accurately captured by bus route and a geographical location (x,y co-ordinate) a number of analyses could have been performed (Newton, 2004). However, due to the way the location of bus crime and disorder data was captured, it was necessary to adapt the analyses that could be adopted for this research. This varied across all three case study areas, and as a result of this the basic areal unit used for the analysis varied by case study area. In addition information available to be used as a denominator (to produce bus crime rates) also varied by study area, and this also influenced the areas chosen as the basic units of analysis. It was originally intended that bus crime would be separated by type of bus crime, but due to small numbers this was not possible, as too many of the areas would have contained zero values. Thus all bus crime was grouped into one category.

In South Yorkshire the location of bus crimes were reported by the location of the nearest stop only. Information on route frequencies and passenger volumes were not available and census output areas were used as the basic unit of analysis. Bus crimes were therefore calculated by census output area as a rate per bus stop and a rate per residential population. 4279 Output Areas in South Yorkshire were used for this analysis.

In Merseyside bus crimes were recorded by bus route number only, and no additional information was collected on where along the route a bus crime occurred. Information was also supplied on route frequency. The census output areas were chosen as the basic unit of analysis, as additional data on census, deprivation and land use variables were available at this level of analysis. 5603 Output Areas in Merseyside were used for this analysis.

In London the location of bus crime and other crimes were recorded using a grid reference system (250m grid squares). Thus it was not appropriate to use output areas as the basic unit for this analysis. Due to the number of incidents in each grid square, these grids were aggregated into larger zones, each containing four adjacent 250m grids along the bus route. Data were provided for four corridors in Greater London, one from each of the North, South, East and West areas the TOCU operated within.

A fairly complex methodology was used to generate bus risk on Merseyside by output area. For each output area, the GIS intersect command was used to extract all routes that traversed that output area. Each route was therefore now divided into route segments split by output area. For each route it was impossible to determine whether or not a bus crime occurred on any particular segment along the route. Thus, a decision was taken to allocate the number of incidents that occurred on an individual route to all route segments along that route. An alternative would have been to allocate the total number of incidents divided by the number of route segments, as the number of incidents for route each segment. This was not used due to small numbers involved. Therefore, the bus crime measure used in this case study area was a 'relative' measure of risk and not an 'absolute' measure of risk. This risk was then aggregated for each output area, using all route segments that went through that output area.

#### Other crime and disorder

To compare bus risk by area with 'other' crime and disorder, the number of incidents of 'other crimes' were aggregated by analysis unit (output area in South Yorkshire and Merseyside and 250m grid square in London). This was done by all 'other' crime types supplied, and by the individual crime types supplied (see table one). For each output area or grid square area these crime and disorder counts were ranked, and then all output areas or grid squares in that study area were divided into deciles for each of the selected crime types. Therefore, in South Yorkshire for example output areas in decile one for criminal damage were the ten percent of areas with the lowest number of incidents in that case study area, and those in decile ten were the ten percent of areas with the highest levels of criminal damage.

The 'other' crime deciles were then compared with bus crimes. For South Yorkshire all bus crime in each output area was aggregated by each of the ten 'other' crime deciles. This was repeated for each 'other' crime type. A bus crime rate was then calculated using residential population (census 2001) and number of bus stops for each decile. Thus a comparison could be made between the other crime and the rate of bus crime. In Merseyside a similar approach was adopted. However due to available information, bus crime rates were calculated for each of the police crime deciles as: a rate per 100 metres of route length; a rate per 10 services a week, and a rate per number of bus stops. In London a similar analysis was used but using the 250m grid squares. Due to small numbers these were grouped into zones with four adjacent 250m grids along the route. The 250m grid zones were not coterminous with census output areas thus it was not possible to extract population data from this. Hence, the bus crime incidents are presented as total counts as no data on route frequency or passenger volumes were available at that level.

### Other environmental influences

Three additional analyses were carried out using the Merseyside data. The bus route crime risk was compared with the Index of Local Conditions (ILC), the SuperProfile Lifestyles and the amount of built up areas. The ILC was separated into deciles from one to ten, ten types of Superprofile Lifestyles were used, and the percentage of built up area in output areas was converted to a deciles score. Thus the analysis of bus risk by land use and socio-economic characteristics again compared output areas using deciles scores.

### Limitations and Possible Other Approaches

A possible methodology that could have been employed would have been to run bivariate correlations to examine the relationship between each of the crime and disorder types, bus crime, and other socio-economic and land use variables. However, due to the limitations described previously it is difficult to be confident about the accuracy of the location of the recorded bus crime. Thus significance measures of such relationships may not be valid due to errors in the location of the bus crime data. For these reasons this analysis was not undertaken.

One of the advantages of the approach described above is that although the location of bus crime and disorder was recorded in different ways across the case study areas, the results that emerged were broadly similar. This represented some degree of corroboration and triangulation of the study's key findings.

## RESULTS

Before examining individual crime risk along buses, it is useful to provide some estimates of the overall level of bus crime risk in each of the case study areas.



### Overall rates of bus crime

In South Yorkshire there were an estimated 125 million passenger journeys made during 2003. There were approximately 2,500 bus route incidents reported during this period which equates to roughly one incident per 50,000 passenger journeys. In Merseyside approximately 170 million passenger bus journeys were made in 2003. For the corresponding period there were approximately 3000 crime and disorder incidents reported, which equates to approximately one incident every 55,000 bus journeys. Finally in London, there were approximately 1534 million bus passenger journey made during the financial year 2002/2003. There were approximately 35,000 bus route incidents recorded which is the equivalent to approximately one incident every 45,000 bus passenger journeys. This suggests that for the three cases study areas there was 1 bus route crime incident per 45,000 to 55,000 passenger journeys.

As discussed earlier it is thought that the number of bus crimes reported will be an underestimate. Although there are not any statistics on this in the UK, a Los Angeles study suggested that the true figure was between twenty to thirty times higher than that reported. Even allowing for this under-estimate the true level of victimisation would only amount to one bus route crime incident per 1,500 to 3,000 passenger journeys. This figure demonstrates the relative safety of using buses compared to passengers' perceptions of personal security, as highlighted by a number of surveys (DETR, 1998; Baker and Bewick, 2001).

### The influence of crime in the surrounding area on bus crime risk

The analysis of bus crime risk by other crime (based on police recorded crime deciles) generated some interesting findings. These are summarised below using a series of figures.

Figures 1 and 2 show for South Yorkshire and Merseyside respectively, the relationships between bus crime and 'other crime' (all selected crime types). It is evident that there are no obvious relationships between bus crime and 'other' crime when looking at all crime types. In figure 1 in South Yorkshire there appears to be a positive relationship between bus crime per 10,000 persons (residential population) and 'other' crime. However, this figure may be skewed by the use of residential population as a denominator for bus crime. When looking at bus crime per number of bus stops (figure 1 in South Yorkshire), or by length of bus route, frequency of buses, and number of stops in Merseyside (figure 2) there are no obvious patterns evident. It is likely that bus crime is not related to all crime types extracted from police recorded crime, thus each individual crime type was analysed further to examine whether any patterns or trends existed.

Figure 1: South Yorkshire bus route crime and 'other' crime (all selected categories), 1<sup>st</sup> Oct 2002 to 31<sup>st</sup> September 2003

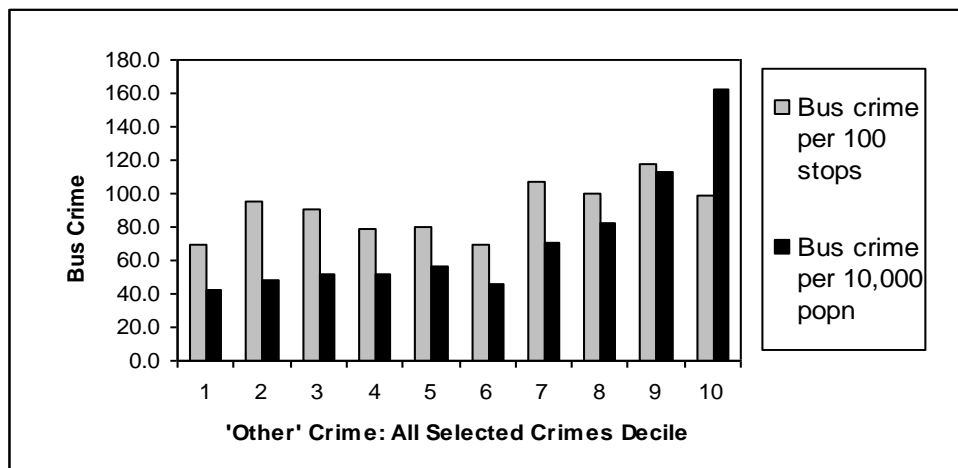
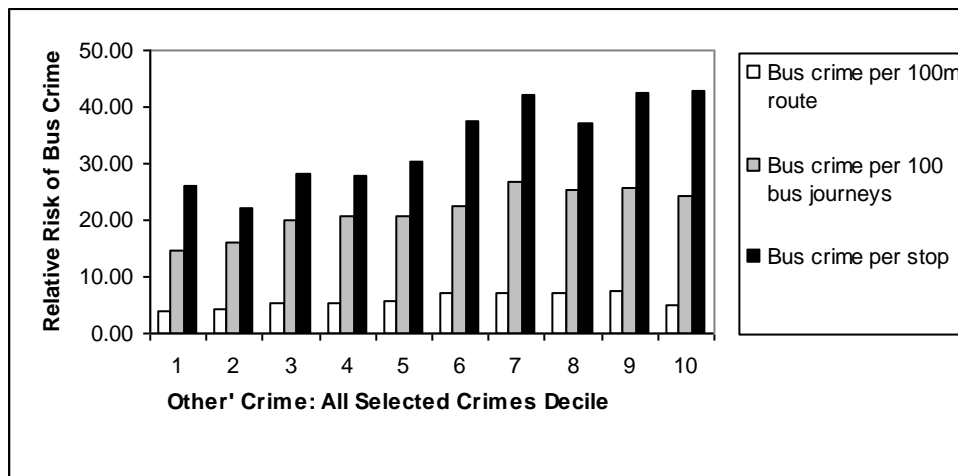


Figure 2: Merseyside bus route crime (relative risk) and 'other' crime (all selected categories), 1<sup>st</sup> January 2002 to 31<sup>st</sup> December 2003



Figures 3 to 5 show the relationship between bus crime and specific types of 'other' crime for South Yorkshire and Merseyside. It is apparent from figure 3 (South Yorkshire) that there is a positive relationship between areas with high levels of bus crime and high levels of criminal damage. Figure 4 shows a similar relationship between bus crime and violence against the person in Merseyside, and figure 5 shows a positive relationship between high levels of disorder and high levels of bus crime in Merseyside. These relationships are evident when looking at bus crime by number of bus stops, frequency of buses services, and length of bus route in an area.

Figure 3: South Yorkshire bus route crime and 'other' crime (criminal damage decile), 1<sup>st</sup> Oct 2002 to 31<sup>st</sup> September 2003

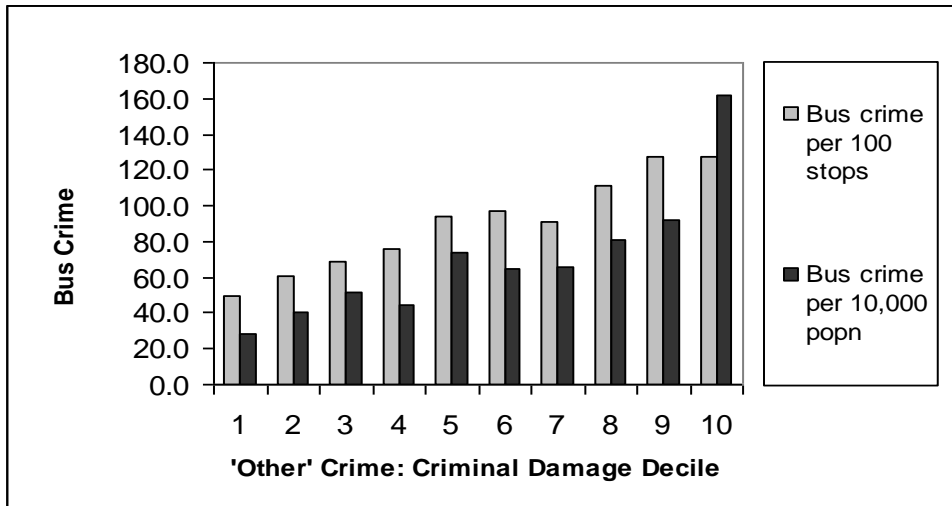


Figure 4: Merseyside bus route crime (relative risk) and 'other' crime (violence against the person decile), 1<sup>st</sup> January 2002 to 31<sup>st</sup> December 2003

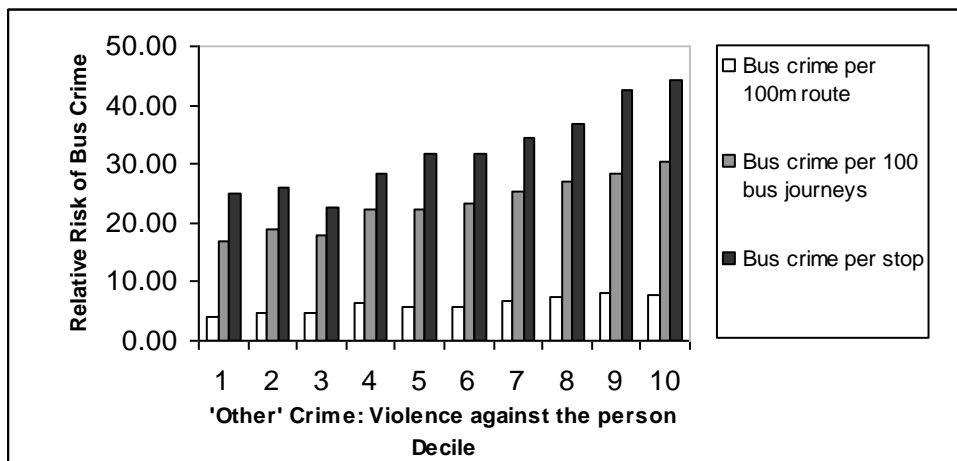
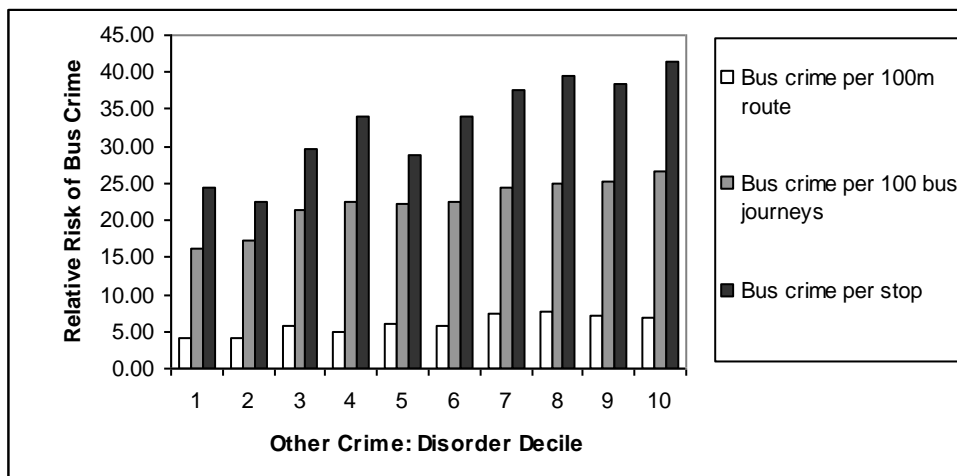


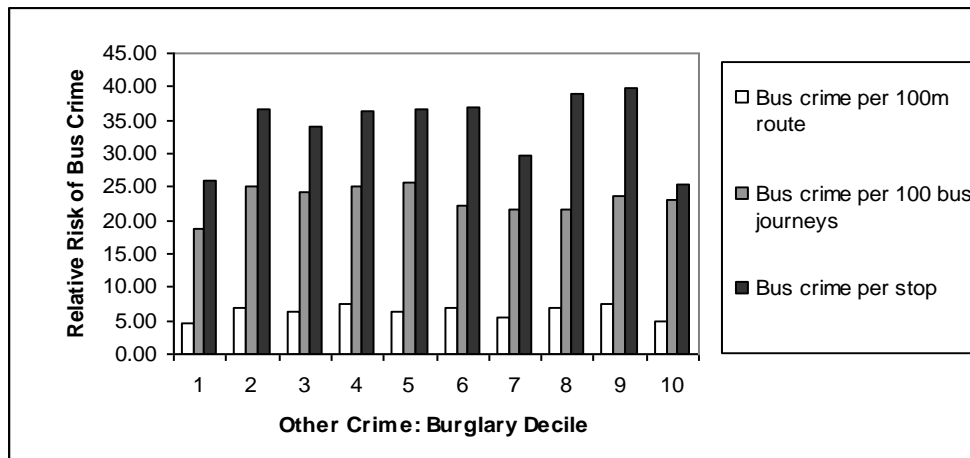
Figure 5: Merseyside bus route crime (relative risk) and 'other' crime (disorder decile), 1<sup>st</sup> January 2002 to 31<sup>st</sup> December 2003



The analyses of the bus crime and other crimes for both South Yorkshire and Merseyside found that the positive correlations between bus crime and ‘other’ crime in an area held true for a number of crime types. Not all of the results from the analysis are presented here. However it was evident that bus crime was found to be positively correlated with the following crime types in both areas; violence against the person, criminal damage; robbery and assault; theft of/from motor vehicle; theft from person/shoplifting/handling stole goods/going equipped for theft; disorder, and specifically youth disorder. Therefore, buses travelling through areas with high levels of particular types of offence are likely to be at greater risk of sustaining a crime and disorder incident during their journey

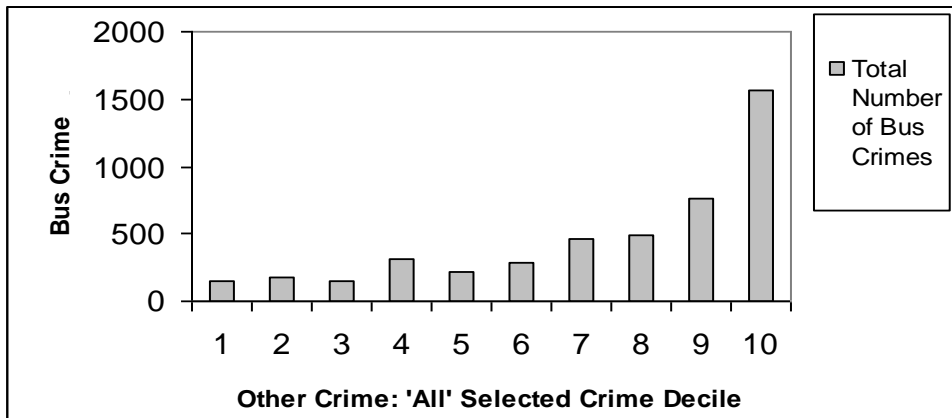
However, with some of the categories selected, there were no apparent relationships between bus crime and ‘other’ crime. Figure 6 shows the relationship between burglary and bus crime in Merseyside. It is evident that areas with high levels of burglary do not necessarily correspond with areas with high levels of bus crime. Indeed, this research found that for both ‘theft other’ and ‘burglary’ there was not a strong relationship between bus crime and these crime types. This was apparent in both case study areas.

Figure 6: Merseyside bus route crime (relative risk) and ‘other’ crime (burglary decile), 1<sup>st</sup> January 2002 to 31<sup>st</sup> December 2003



In London data were obtained for four TOCU corridors, and the unit of analysis here was 250m grid squares (due to the reporting of location mechanism). The results of this analysis are presented in Figure7. This shows a strong relationship between areas with high levels of other crime and high levels of bus crime. In the twenty percent of areas with the highest levels of other crime (deciles nine and ten) approximately eighty percent of the bus crimes occurred. It is important to highlight here that incidents extracted from the police records for ‘other’ crimes were pre-selected by TOCU as those that they thought had the highest correlations with bus crime, and it is evident that the relationship here appears stronger than in other areas. Note that the ‘other’ crime category does not include bus crime incidents. This adds further weight to the existence of a relationship between high crime areas (for specific crime types) and the risk of crime for buses that traverse these areas.

Figure 7 London bus route crime and 'other' crime (all selected categories), 1<sup>st</sup> January 2003 to 31<sup>st</sup> December 2003



### The influence of environmental characteristic on bus route crime

In addition to crime risk, a further objective of this research was to examine other environmental factors which may influence crime risk along bus routes. Due to difficulties in obtaining crime and other data, this analysis was only performed for Merseyside. Figures 8 to 10 show the findings of an analysis of levels of bus risk by socio-demographic characteristics using the Superprofile Lifestyles in figure 8), deprivation (using the index of local conditions in figure 9) and land use (using the percentage of area built up in figure 10).

Figure 8 shows that the more deprived areas (deciles nine and ten) have a higher risk of bus crime than the less deprived areas (deciles one and two). A similar pattern for deprivation is found for the index of local conditions in figure 9. A further additional feature is that decile five of the Superprofile Lifestyle classification is for 'urban ventures'. The latter describes areas with an over-representation of mobile single person households and high population turnover. This area type had a high risk of crime similar to that found in the more deprived areas. This suggests that the socio-demographic composition of areas might play an important role in shaping the level of bus crime risk. Figure 10 shows that areas which are more built up (deciles nine and ten) are also more susceptible to bus route crime than those areas with fewer built up areas. These figures all add weight to the argument that land use, the physical infrastructure and socio-economic factors all influence the risk of bus route crime along a bus route.

Figure 8: Merseyside bus route crime (relative risk) 1<sup>st</sup> January 2002 to 31<sup>st</sup> December 2003 and Superprofile Lifestyle

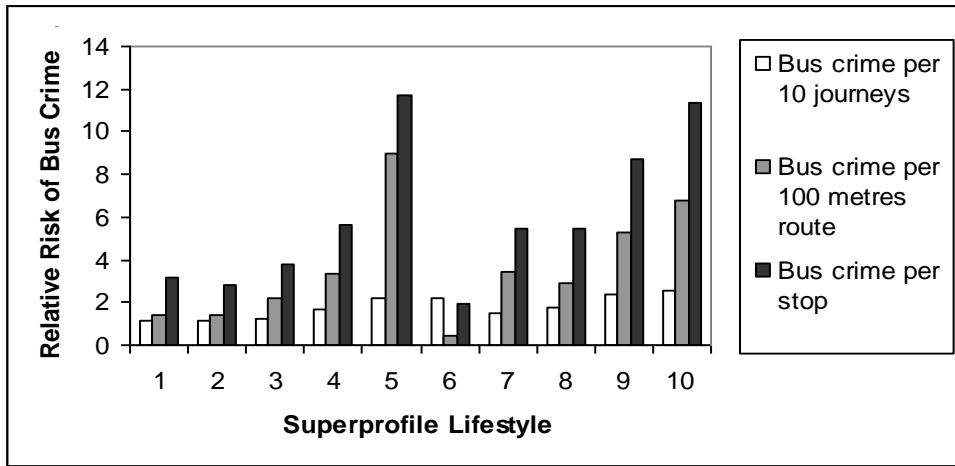


Figure 9: Merseyside bus route crime (relative risk) 1<sup>st</sup> January 2002 to 31<sup>st</sup> December 2003 and Index of Local Conditions

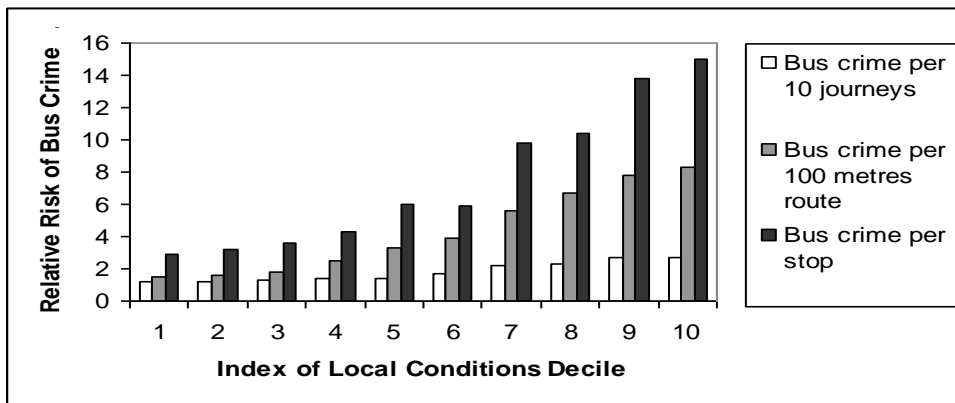
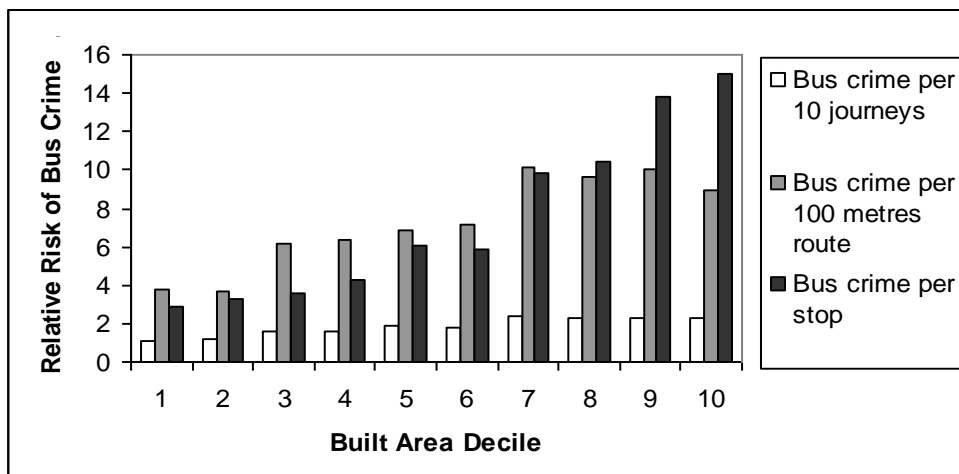


Figure 10: Merseyside bus route crime (relative risk) 1<sup>st</sup> January 2002 to 31<sup>st</sup> December 2003 and 'Built Up' Areas



## DISCUSSION AND CONCLUSIONS

There are a number of important findings that emerge from this research. The first of these is that the total number of bus crimes is relatively low. Put into context, the number of incidents reported for the London, South Yorkshire and Merseyside case studies, ranged from 1 incident per 45,000 to 55,000 bus passenger journeys (1,500 to 3000 if adjusted for estimated levels of under-reporting). This suggests the relative level of safety in using buses in urban areas.

### Key findings

The research has provided strong evidence to suggest the following:

- Crime levels in general in the areas a bus traverses during its journey will influence the levels of crime and disorder the bus experiences
- The risk of crime (to passengers, staff and vehicles) on those routes that traverse high crime areas is greater than on other routes.
- The risk of crime on routes that go through high crime areas with relatively high numbers of stops are at greatest risk (multiple entry and exit points for offenders)
- The risk of crime during a journey is heightened when the bus is in a high crime area, and this is reduced in low crime areas.

It is important to emphasise that this is crime type specific and does not hold true for all crimes types. Those shown to relate to bus crime include: violence against the person; criminal damage; robbery and assault; theft of/from motor vehicle; theft from person/shoplifting/handling stole goods/going equipped for theft; disorder; and specifically youth disorder. These findings were found across two or three different case study areas (depending on data availability) using different data sets and different analytical approaches, thus a triangulation of both the data and methodology suggests a corroboration of results across the three case study areas.

In addition, the study suggested that land use, socio-economic data and the physical infrastructure of areas all influenced bus route crime. Areas with higher levels of deprivation and built up areas experienced higher levels of bus crime than other areas. Additionally areas classified as 'urban venturers' (a more mobile community) also had higher levels of bus crime. Thus in addition to bus crime, it is likely that land use and socio-economic factors will influence bus crime risk. This is an area fruitful for further research.

### Implications for crime prevention

There are a number of crime prevention implications that arise from these findings. Bus route crime is concentrated by route and location, and by time of day and incident type. This information should be reflected into any future crime prevention measures.. The research underlines the relatively low numbers of bus crime incidents compared to the public's perception of bus crime. It highlights the importance of not only tackling bus

crime, but also the need to develop measures to reassure the public about the safety of using buses.

It is suggested that schemes to tackle high crime bus corridors should also be used in conjunction with schemes to tackle high crime areas (for selected crime types as described above) due to the apparent relationship between the two. The TOCU system at present is the most comprehensive system for this in England and Wales, using both bus crime data provided by both the operators and extracted from police records. However, in the absence of bus crime data, police recorded crime incidents and command and control records for selected crime types could be used to indicate areas which are likely to experience high levels of bus crime

### Future research

This study has demonstrated the difficulties in obtaining suitable data on levels of bus crime, and one of the major obstacles for this research was in obtaining appropriate data for this analysis. There is a need to encourage good practice schemes that facilitate the reporting, capture and analysis of bus crimes. These schemes need to be designed in conjunction with both analysts and those reporting the incidents (revenue inspectors and bus drivers for example) to ensure a simple to use robust procedure that systematically collects consistent and reliable information to inform future prevention and enforcement.

There were numerous difficulties in obtaining much of the data for the research due to concerns over the Data Protection Act. The data obtained for this research were depersonalised but contained individual x,y co-ordinates (disaggregate data), thus it was necessary to draw up data sharing protocols with the police. This is a further step transport operators may need to overcome in order to share data with the police for crime prevention strategies.

Once better data of bus crime and disorder become available, it will be possible to develop more detailed profiles of bus crime risk. Future research should run statistical significance testing of relationships (using more reliable locational data). Additionally, more variables about land use and socio-economic influences should be built into the analysis. It may be possible to run multiple regression models to examine which variables are most likely to influence bus route crime. Finally, it is essential that bus crime is examined by type of bus crime and also temporally (by time of day, day of week, and month for example). This will allow for a better understanding of the spatio-temporal patterns of bus crime and disorder, and how this varies by crime type (for example criminal damage to buses versus assault to passengers) and by time of day (e.g. 4.00pm compared to 11.00pm). At present the main limitations to this are the lack of available data and the limited number of techniques that have been applied to study linear patterns of crime.



## **Appendix: Super Profile Lifestyles Description**

This is a text and bullet point description of the area types that characterize each Lifestyle Cluster of the Super Profiles Classification (after Brown and Batey, 1994)

### **Lifestyle 1: 'Affluent Achievers'**

High income families, living predominantly in detached houses. The Affluent Achiever typically lives in the stockbroker belts of the major cities, and is likely to own two or more cars. Area types include:

- Very High Income Professionals in Exclusive Areas
- Mature Families with Large Detached Properties in 'Stockbroker Belts'
- Mature Families in Select Suburban Properties

### **Lifestyle 2: 'Thriving Greys'**

Generally older than Affluent Achievers, possibly taking early retirement, the Thriving Greys are also prosperous. Their detached or semi-detached homes have been completely paid for, and children have grown up and left home.

Area types include:

- Highly Qualified Professionals in Mixed Housing
- Affluent Ageing Couples, Many in Purchased Property
- Older Professionals in Retirement Areas
- Comfortably Well-Off Older Owner Occupiers
- Affluent Ageing Couples in Rural Areas

### **Lifestyle 3: 'Settled Suburbans'**

Well-established families in generally semi-detached suburban homes. Settled Suburbans are employed in white collar and middle management positions, while in addition many partners work part-time. Area types include:

- White Collar Families in Owner Occupied Suburban Semis
- Mature White Collar Couples Established in Suburban Semis
- White Collar Couples in Mixed Suburban Housing

### **Lifestyle 4: 'Nest Builders'**

Typically young adults in their thirties who have recently started a family, the Nest Builders are middle management, white collar workers. Area types include:

- Mortgaged Commuting Professionals, with Children, in Detached Properties
- Double Income Young Families in Select Properties
- Military Families
- Young White Collar Families in Small Semis and Terraces
- Young White Collar Families in Smaller Semis
- Young Blue and White Collar Families in Semis and Terraces
- Young Families in Terraces - Many Council

### **Lifestyle 5: 'Urban Venturers'**

Cosmopolitan, multiethnic areas of major cities that are undergoing gentrification but retain a significant proportion of poorer quality housing. These young adults live in terraced houses or flats. Close to busy areas, there is little need for a car, so forms of public transport (bus, train, and the tube) are preferred. Area types include:

- High Income Young Professionals, Many Renting (mainly Greater London)
- Young White Collar Families in Multi-Ethnic Areas (mainly Greater London)
- Young Professionals Buying Property
- Young Families Buying Basic Terraces in Multi-Ethnic Areas
- Young Families Renting Basic Accommodation in Multi-Ethnic Areas
- Young White Collar Singles Sharing City Centre Accommodation

### **Lifestyle 6: 'Country Life'**

Rural in nature, this group live and work in the countryside. Many live on farms or in tied cottages, which are concentrated in East Anglia, Scotland, Wales and the South West. Area types include:

- Prosperous Farming Communities
- Small holders and Rural Workers, Mainly in Scotland

### **Lifestyle 7: 'Senior Citizens'**

An elderly group living in small, possibly sheltered accommodation. Many have moved into retirement areas and there are many lone single female pensioners. Area types include:

- Retired White Collar Workers in Owner Occupied Flats
- Older Residents and Young Transient Singles, Many in Seaside Towns
- Old and Young Buying Terraces and Flats
- Retired Blue Collar Workers in Council Flats, Mainly in Scotland

### **Lifestyle 8: 'Producers'**

These more affluent blue collar workers live in terraced or semi-detached housing. Many are middle aged or older and their children have left home. The Producers work in traditional occupations and manufacturing industries, where unemployment has risen to a significant level.

Area types include:

- Older White Collar Owner Occupiers in Semis
- Older Workers Established in Semis and Terraces
- Older and Retired Blue Collar Workers in Small Council Properties

### **Lifestyle 9: 'Hard-Pressed Families'**

Living in council estates, in reasonably good accommodation, unemployment is a key issue for these families. Many work is found in unskilled manufacturing jobs, if available, or on Government schemes.

Area types include:

- Blue Collar Families in Council Properties
- Young Blue Collar Families in Council Terraces
- Manufacturing Workers in Terraced Housing

### **Lifestyle 10: 'Have Nots'**

Single parent families composed of young adults and large numbers of young children, living in cramped flats. These are disadvantaged communities with two and a half times the national rate of unemployment, and with low qualifications. Many on Income Support, and those who can find work are in low paid, unskilled jobs. Area types include:

- Families in Council Flats in Multi-Racial Areas. High Unemployment
- Blue Collar Young Families in Council Properties. High Unemployment
- Young Families, Many Single Parent High Unemployment
- Young Singles and Pensioners in Council Flats. High Unemployment

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