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Title: Managing Crime and the Fear of Crime at Railway Stations. A Case Study in South Wales (UK).

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Abstract:

Rail users consistently perceive their risks from crime to be significantly higher than official statistics suggest, discouraging many from using rail transport. The aims of the paper include a discussion of Crime Prevention Through Environmental Design (CPTED) and current policy initiatives for reducing crime and the fear of crime on the railways. This exploratory study focuses on adult passengers' perceptions of crime and nuisance as they relate to the management, design and maintenance of railway stations and their immediate access routes. The study innovatively utilises interactive virtual reality (VR) scenes of 'representative' stations as the environmental stimulus and concludes that such an approach provides an analytical and pragmatic framework for managers of railway stations that are unlikely to receive Secure Station accreditation.

Keywords: Railways stations, cartographies of fear, personal safety, 'virtual reality' (VR) walk-through scenes, crime prevention through environmental design (CPTED).

1. Introduction

Crime and fear of crime are increasingly important issues for society and those responsible for the management of Britain's towns and cities, and especially the vital transport systems. According to the British Transport Police recorded crime on the railways rose by 5.6% in 2001-2002 (Guardian, 2002). This paper discusses the theory and practice of Crime Prevention Through Environmental Design (CPTED) as it has been variously implemented on the railways and reviews some of the current policy initiatives for managing the reduction of crime on the railways. However, the government's flagship policy initiative is the Secure Stations Scheme (based predominantly upon CPTED ideas), which crucially, is not applicable to the majority of Britain's railway stations (see section 2.3). This study conducted in South Wales (see Figure 1) presents an alternative approach to reducing crime and fear of crime for train operating companies (TOCs) and those responsible for the management of those stations unlikely to fall under the remit of the Secure Stations Scheme.

Figure 1. Map of the United Kingdom

2. The Railways, Crime and Fear of Crime

Brantingham *et al.*, (1991) cite five means by which the mode of transport can affect criminal opportunities. Firstly, different transport modes manage people in different ways. Car travel is predominantly 'private', involves individuals or small groups, who are insulated and usually well-acquainted. Public transport involves large numbers of strangers, held together for discrete periods of time. Private car users cluster in socially / demographically similar groups while public transport produces clusters which are more diverse and contrasted. Crime risk on public transport is apparent at point of origin, the journey itself and at the destination, and offenders therefore have greater numbers of potential victims from which to select.

Secondly, modes of travel shape different travel experiences. The car is versatile and flexible while public transport has fixed schedules, clustering people at specific times, with varying but predictable densities. This therefore presents time frames where risk can be calculated to be higher or lower by both potential offenders and their victims.

Thirdly, different modes of transport cluster destinations differently. Private car users can move between an infinite number of potential destinations, while public transport users must enter and exit the system at a limited number of origins and destinations. Victims therefore cluster at predictable locations and facilitate selection by potential offenders (Angel, 1968). Indeed, more than half of all bus-related crime was found to occur at the bus station itself or whilst in its immediate proximity (Levine and Wachs, 1986).

Fourthly, travel paths are clustered differently. The private car user can use many travel paths between destinations and thus awareness spaces can be shaped accordingly. Public transport travel paths are defined, and entrance to these pathways are restricted, more so in the case of

the 'closed' system of the underground, and to a lesser degree, the railways. Crimes committed by those who use public transport and their victims will therefore be more highly concentrated in both time and space than crimes associated with car users.

Finally, different modes of travel shape the type of crime by creating different opportunity sets for offenders. For car travel, offenders must search for suitable, and preferably unguarded targets with rewards that are capable of being removed and easily transported and placed in the boot of a car for example (not so readily executed on public transport).

However, the car can provide clustered targets in the form of car parks and residential parking areas. Public transport tends to facilitate crimes against the person where target density is crucial (e.g. pick-pocketing and mugging). It also generates high volumes of crimes against the system itself (unpaid fares, vandalism and graffiti) as a by-product of handling large volumes of people over time. They note that public transport also mixes people of different backgrounds and includes "demographically high-crime-risk people" such as teenagers, unattached males and those of low socio-economic status. They conclude (Brangtingham *et al.*, 1991, p93) "transit shapes crime patterns of the city by moving large proportions of high-risk populations around the city along a limited number of paths and depositing them at a limited number of destinations".

To combat such risks, the theory of Crime Prevention Through Environmental Design (CPTED) is increasingly being utilised by urban designers, town planners, city centre managers and public transport operators to tackle crime and the fear of crime at the site-specific level. The study presented in this paper is concerned with investigating crimes against the system (e.g. vandalism and graffiti), crimes against people in transit (specifically those waiting on the platform / in the shelter) and crimes against users and others on the

station approaches. The study utilises elements of CPTED in its approach, which asserts that the physical environment can encourage or discourage opportunities for crime by its very design and management. Optimising opportunities for surveillance, clearly defining boundaries (and preferred use within the space) and creating and maintaining a positive image of the physical fabric are basic elements to the theory underpinning CPTED. This approach asserts that a potential offender may be discouraged from offending by the fact that they are more visible to 'law-abiding' others and therefore more at risk of apprehension. CPTED theory assumes that the motivated opportunistic offender makes a 'rational choice' (Clarke, 1992) in any decision to offend, often within the confines of their daily 'routine activities' (Cohen and Felson, 1979; Felson, 1994). Crowe (2000, p1) defines CPTED as being based upon the assumption that "...the proper design and effective use of the built environment can lead to a reduction in the fear of crime and the incidence of crime, and to an improvement in the quality of life" (Crowe, 2000, p1).

2.2 Policy

Various government initiatives are in place that seek to provide an effective, safe and thriving public transport network that is essential for employment, education, commerce, industry, recreation / leisure, tourism and shopping. The Ten Year Transport Plan, Transport 2010 (DETR, 2000) has set out the government's proposals for the long-term development of the national transport infrastructure and explains how the proposals address the objectives of the Integrated Transport Policy. The crucial importance of creating and maintaining 'safe' travel for the public is a primary objective; "we want people to travel safely and to feel secure whether they are on foot or bicycle, in a car, on a train, or bus, at sea or on a plane"(DETR, 2000, p75). Furthermore, the government's public policy guidance on transport (PPG13)

states “local authorities in partnership with the police should promote designs and layouts which are safe (both in terms of road safety and personal security) and take account of crime prevention and community safety considerations” (DETR, 2001, p8).

The UK government clearly recognises the crucial role of design in facilitating or discouraging criminality. The Planning Out Crime circular 5/94 (DOE, 1994), British standards (BS8220), various policy guidance notes and Section 17 of the Crime and Disorder Act (1998) illustrates this commitment. Indeed, it has been asserted that “there is now an established link both between design and crime and the reduction of fear” (DETR, 1998a). One such initiative specific to the railways is the Secure Station Scheme which is discussed in more detail below.

2.3 Practice

Much research has attempted to measure the impact of a variety of potential ‘solutions’ designed to reduce recorded crime rates in the railway environment. Studies in Australia have found that CPTED measures can reduce incidents such as fare dodging and vandalism on public transport (Easteal and Wilson, 1991), while enhanced lighting (Grabosky and James, 1995) and reducing the number of train carriages (Urjadko, 1991) can reduce levels of fear. Carr and Spring, (1993) studied the ‘Travel Safe’ programme in Victoria, (Australia), and found that a broad range of CPTED measures reduced recorded crime and the fear of crime on public transport. Internationally, ‘good’ design was found to contribute to low crime on Hong Kong’s Mass Transit System (Gaylord and Galliher, 1991) and in Washington’s Metro system (La Vigne, 1997). More uniformed staff have been found to enhance security awareness (Collins, 1993) although the ‘Guardian Angels’ were not found to reduce recorded crime on the subways in New York (Kenney, 1987) or on the underground in London (Webb

and Laycock, 1992). High visibility foot patrols, in conjunction with CPTED and rapid maintenance and repair of any damage have more recently found to be effective in reducing crime rates and fear of crime (Sullivan, 1996). A study by the Parliamentary Travel Safe Committee (1998) in Brisbane, (Australia), recommended a wide-range of measures to reduce crime and the fear of crime; including CPTED audits at each station. However, Eck (1997) reviews various studies of public transport (Kenney, 1987; Poyner, 1988; Carr and Spring, 1993; La Vigne, 1997) and claims that despite the studies, little is currently known about the effectiveness of such interventions. The variety of crimes, number of different settings in the transport system and the variety of victim types effectively means that; “we cannot therefore, identify with reasonable certainty, any specific tactic against specific crimes, that can be said to ‘work’ across similar settings in other cities” Eck (1997, p16).

Crucially, recorded crime statistics represent only a fraction of total crime, according to the British Crime Survey (Mirlees-Black *et al*, 1998). The missing data representing the ‘dark figure of crime’ (Maguire, 1997) that may not be witnessed or discovered, or remains either unreported or unrecorded – for a variety of complex reasons. The transport environment is no different, and crime probably remains significantly under-reported, an issue recognised by government; “a large proportion of crime on public transport is not reported” (DETR, 1998b). Reluctance to delay one’s journey, a lack of confidence that the offender will be apprehended, the absence of someone to actually report an incident to, and the belief that a reported incident will not be taken seriously are examples of non-reporting behaviour.

Victimisation surveys have been developed to attempt to address this shortcoming and the study of the fear of crime has recently emerged as an important alternative policy objective. Reported crime on the railways is low, however, the perception of crime has consistently

been found to be significantly higher according to rail-users' customer surveys. Fear of crime in the residential environment can result in the withdrawal of the community and a reduction of crucial 'eyes on the street' that can actively contribute to policing a neighbourhood (Jacobs, 1961; Newman; 1973). Similarly, perceptions of crime on the railways will undoubtedly affect levels of usage. In a study of public transport in Canada, Brantingham *et al.*, (1991, p93) concluded that "fear of crime is a matter of substantial concern for public transit authorities because it can deleteriously affect utilisation levels". Measuring the impact of fear of crime upon non-use of the railways is highly problematic and remains largely unexplored. However, Carr and Spring (1993) argue that the impact of fear of crime can be significant and provide an interesting illustration of the dynamics by which fear of crime may perpetuate itself (see Figure 3).

Figure 3. The Cycle of Fear

However, it is highly probable that individual characteristics (i.e. such as gender, disability, age and ethnicity) will also be variables worthy of further analysis that are not currently incorporated within Carr and Spring's interpretation of the cycle of fear.

Crucially, Crime Concern and Transport and Travel Research (1997) found that 43% of women and 18% of men felt that rail travel in the UK was 'unsafe' and suggested that there might be as much as a 15% increase in all train journeys if a range of personal security measures were implemented. Crucially, Clarke (1996, p3) observes; "...the fear of crime that stops many people using public transport has a serious impact on revenues". Furthermore, Crime Concern and Transport and Travel Research (1997) argue that "there is significant

potential to increase the use of public transport by making passengers feel safer” (Crime Concern and Transport and Travel Research, 1997, p22).

The role of perceptions in understanding CPTED is clearly crucial, and has been highlighted with regard to residential housing (Tijerino, 1998; Ham-Rowbottom *et al*, 1999; Cozens *et al.*, 2001a). Regarding public transport, perceptions are no less important, as noted by the Legislative Assembly of Queensland (Australia); “the public’s perception of crime is an important determinant of people’s usage of public transport” (Parliamentary Travel Safe Committee, 1998, p16).

In terms of current initiatives, the Secure Station Scheme is operated jointly by Crime Concern and the British Transport Police and is arguably central to the government’s ideas for reducing crime and the fear of crime in and around railway stations, theoretically and operationally. The award has currently been accredited to over one hundred and fifty railway stations in the U.K and represents “... an opportunity for Britain’s rail companies to improve security at their stations and display to customers their desire to reduce crime” (DETR, 1998a, p1).

It acknowledges that the fabric of many railway stations may be antiquated, decayed and not initially designed with crime and nuisance in mind and that levels of security can be improved through physical design measures, management practices and procedures.

Crucially, the monitoring and management of crime and the investigation of perceptions of passengers are central elements to this approach. The design recommendations are not prescriptive, and should be modified to reflect localised characteristics. To ascertain the appropriate implementation of measures, site-specific surveys are essential. The number of accredited railway stations continues to rise and the British government intends to increase

this number (DETR, 2000), although this currently represents only 3% of Britain's two thousand five hundred or so railway stations (Lashmar, 2001). Furthermore, no study has yet evaluated the effectiveness of the scheme in actually reducing recorded crime rates or the occurrence of nuisance activities or incivilities.

However, the accreditation can only be given to railway stations that exhibit a threshold level of reported crime as a percentage of levels of passenger throughput – ignoring large numbers of railway stations with either high crime rates or low throughput levels – or both. Indeed, for most of Britain's railway stations (which are unstaffed) the scheme is not applicable. For railway stations outside the scope of the Secure Stations Scheme, train operating companies (TOCs) therefore require an alternative framework for reducing crime and the fear of crime at railway stations under their management. Indeed, Clarke (1996) has called for more studies to be funded by transit authorities and therefore, more communication between railway managers and CPTED theorists. Furthermore, the Head of Rail Research UK, Keith Madelin (2003, p31), recently remarked that the rail industry “has ignored the potential benefits of academic research into new technologies and systems that could help to solve some of its problems”.

The innovative use of virtual reality (VR) technology to probe passengers' perceptions of personal safety in and around the railway station environment is presented as a novel way forward. This paper presents the findings from an example of such research.

3. A Study of Valley Lines (Wales and Borders Trains) in South Wales (UK)

The Valley Lines rail network (part of the Wales and Borders franchise) is located in South Wales (see Figure 4) and serves the communities of the Rhondda, Cynon and Taff Valleys, in addition to stations in Cardiff, Barry and Penarth (see Figure 4). British Transport Police

(BTP) statistics reveal that 459 crimes were recorded on the Valley Lines' 66 railway stations which operated 7.3 million passenger journeys annually (2000-2001). This does not include crimes that may have occurred on the train itself and equates to 6.26 crimes per 100,000 passenger journeys.

Figure 4. Valley Lines Rail Network Map

Customer satisfaction surveys consistently reveal that fear of crime is a significant factor in dissuading both potential rail users from travelling on the railways and existing users from using the service more extensively.

4. Methodology

In order to investigate perceptions of personal safety, a 'representative' sample from the total of 66 railway stations on the network was selected. The railway stations selected for the study needed to be rationally identified and presented as a visual stimulus to the respondents. The 'representative' railway stations were selected to reflect the diverse character of stations on the network in terms of five broad categories (see Table 1).

Table 1. Criteria Used for the Categorisation of Stations

The railway stations were subsequently grouped into one of six 'families'. 'Station Family 1' (SF1) are represented by railway stations which are in / near the capital city. They are in relatively affluent areas, and are well used and staffed with many security features (i.e. CCTV, help points, electronic information), car parking and a frequent service. 'Station Family 2' (SF2) are represented by railway stations that are situated in the Valleys and are

located within deprived communities. They are well used and staffed with many security features, although they do not possess any car parking and are served by an infrequent service. 'Station Family 3' (SF3) railway stations are also situated in the Valleys in more deprived areas. They are well used, staffed and have many security features and car parking facilities. 'Station Family 4' (SF4) railway stations are close to the city, well-used, staffed and have car parking facilities. They serve relatively deprived communities and have few security features. 'Station Family 5' (SF5) railway stations are also close to the city in affluent areas but are unstaffed, with few security features and no car park and possess low levels of patronage. 'Station Family 6' (SF6) includes unstaffed stations in the Valleys with low patronage and are located in deprived areas. They have no car parking and an infrequent service.

Having selected six railway stations to reflect the diverse characteristics of the stations on the Valley Lines network, a representation of the station, car park and immediate access route, in the form of an environmental stimulus, was required for presentation to the specific rail user groups. The stimulus could then facilitate the collection of data in the form of detailed commentary regarding users' 'perceptions'. Some previous studies have actually walked respondents through the journey and surveyed users' responses (Crime Concern and Transport and Travel Research, 1997). In National Passenger Surveys (NPS), TOCS utilise a standardised questionnaire (produced by the Strategic Rail Authority) to probe satisfaction issues and general crime concerns. These are often conducted on trains, at different railway stations and at different times.

Static photographs have long been utilised as a source of environmental stimuli, particularly in the field of environmental psychology and the study of building preferences. Crucially, the

preferences of architects and design professionals have been studied and shown to differ from those of the ordinary citizen. (Groat 1982; Devlin 1990; Downing 1992; Purcell and Nasar 1992; Stamps and Nasar 1997). However, a more standardised approach, which presented images of all of the selected railway stations in an identical and dynamic format to all of the respondents was required.

Crucially, few studies have attempted to investigate how CPTED dimensions are perceived in the British context. Two recent studies (Ham-Rowbottom *et al.*, 1999; Cozens *et al.*, 2001b) utilised photographs as the environmental stimuli and found that perceptions varied between user groups such as burglars, police and residents, relating to various UK housing designs. The utility of photographs has obvious limitations in terms of realistically representing the passengers' 'journey' to, and throughout the station. One obvious option was to video this 'journey'. However, a video would arguably provide a stimulus that could be contrived and crucially, would not allow respondents to view certain features of the station by freely moving through it, as they might wish to do so. Furthermore, creating a video of the journey through a railway station presents obvious operational difficulties such as deploying mobile cameras up and down stairways and in re-visiting different sections of the station when required.

However, it is argued that by more realistically representing the wider environment with the use of a more interactive and dynamic environmental stimulus will fund the provision of more robust, richly detailed data that offers more comprehensive and reliable insights. A virtual reality (VR) walk-through panorama of a commuter's approach from the public spaces onto the access routes (and car park where applicable) and into the railway station environment itself arguably represents a more technologically dynamic alternative. This

involves the photography of several 360 degree 'panoramas' at various points in the environment. These 'panoramas' are then 'stitched' together to create a VR 'walk-through' scene, whereby respondents can 'virtually' travel through the station approach and railway station environment, view in and out and pan left or right at any stage of their 'journey'. The VR 'walk-through' scene has been piloted and provides a more dynamic visual stimulus on which respondents' judgements and perceptions are generated. The VR approach has been critically reviewed at conference (Cozens *et al*, 2002) and received as a highly innovative way forward at peer review sessions and at subsequent presentations to groups of academics, planners and the police. It is presented in this paper as an example of how VR can be operationally applied to the railway station environment and its immediate access routes. It is not possible to present the VR in operation within this paper, however, a still image taken from the VR of one of the stations is provided in Figure 5.

Figure 5. A Still Image from a VR Scene of One 'Representative' Railway Station

An independent company (Adsearch) was employed to select the respondents to form the user groups for this study. They were drawn from regular (daily) to light users (weekend) and ranged from 19-65 years of age with both males and females represented. A total of 47 respondents (twenty-six females and twenty-one males) were interviewed and asked to complete a structured questionnaire following the presentation of a VR 'walk-through' scene of each of the six selected railway stations and their immediate access routes. After the completion of the structured questionnaire, six unstructured focus groups were conducted in the presence of a trained facilitator. Each group ranged in size from 6 – 10 participants and lasted approximately 90 minutes.

The six focus groups were recruited from communities that were local to the six selected railway stations ('Station Families 1-6'). Respondents initially worked within an unstructured discussion covering respondents' attitudes to Valley Lines, barriers to rail use and personal safety fears. The focus groups were then shown the VR 'walk-through' scenes of the railway stations and discussed whether fears for personal safety acted as a barrier to use, factors that reinforce such problems and what would enhance their perceptions of personal safety in and around railway stations. Respondents were observed on television monitors and recorded (audio and video) at the same time as the presentation of the stimuli of the VR 'walk-through' scenes. As part of the structured questionnaire, respondents were specifically asked to state whether they had fears for their personal safety relating to six different component parts of the rail journey, both during the day and after dark (equating to a total of twelve questions). These questions required a binary response (yes / no), designed to dichotomously probe the respondents' 'cartographies of fear' across the railway station environment (temporally and locationally);

- Do you fear for your personal safety when approaching the railway station in the day / *and* after dark.
- Do you fear for your personal safety when using the car park in the day / *and* after dark.
- Do you have any concerns for the security of your vehicle in the car park in the day / *and* after dark.
- Do you fear for your personal safety when waiting for a train on the railway station platform in the day / *and* after dark.
- Do you fear for your personal safety due to an infrequent service in the day / *and* after dark.

- Do you fear for your personal safety when travelling on the train in the day / *and* after dark.

The binary responses generated by the twelve questions above were aggregated and converted into percentage values. This provides sufficient analysis of the data to allow insights into *where* and *when* respondents expressed fear of crime (see Figure 6). The study sought to provide primarily a gender-based analysis of adult male and female rail users.

5. Study Findings

Systematic analysis of the data, both qualitative and quantitative has identified common design features that are repeatedly associated with fear of crime, in addition to highlighting significant differences between different groups of respondents. Specific qualitative comments and observations made by the respondents are presented throughout the text to illustrate their particular concerns and both graphs and tables provide a summary of their responses. For comparative purposes the responses are expressed as a percentage rather than in terms of raw data. Figure 6 illustrates these responses as ‘cartographies of fear’ across the different component parts of the selected railway stations and their immediate access routes.

There appears to be broad agreement regarding both where and when the respondents expressed fear for their personal safety across all six railway stations. For all six railway stations 75% of all respondents stated that they had personal safety fears when waiting on the platform at after dark and 73% stated such concerns when approaching the railway station after dark. There were also concerns over the security of parked vehicles after dark and during the day (mentioned by 66% and 63% of all respondents).

Figure 6. A Cartography of Fear of Crime for the Six Stations

Personal safety fears were also expressed in relation to travelling on the trains at night where 60% of all respondents stated such concerns. A similar rating was expressed while using the car park at night (60%) and as a result of an infrequent train service at night (51%). In all other categories across all six railway stations the respondents' fears were significantly lower and less than 20% of respondents stated that they had such fears. Figure 5 clearly shows that levels of fear are heightened at all railway stations for all respondents at night. Personal safety fears were much lower during the day and although there are differences in the extent of these fears between the males and females interviewed (the females were generally more fearful), the patterns were broadly similar. □ Clearly, the female respondents exhibited far higher concerns for their personal safety than the males in this study. This was particularly the case while approaching the station where 93% of female respondents expressed fears compared to 53% of the male respondents. Similarly, when waiting on the railway station platform at night 93% of the female respondents admitted being fearful compared to 49% respectively, for the male respondents.

“I wouldn't like to walk down there, if I was on my own, especially after dark”

[Note: Female Respondent 3 (F3), Station Family Group 3 (SF3)]

The male respondents expressed their highest level of fears across all the six railway stations in relation to the security of their car at night (58%) and during the day (58%), while also fearing for their personal safety when using the car park at night (58%).

“People don't want to leave their cars there because it's well-known for having your car broken into” *[Note: Male Respondent 1 (M1), Station Family Group 1 (SF1)]*

Visibility of and by others was mentioned by respondents in all the focus groups as being a crucial dimension to their feelings of safety. The proximity of others (e.g. people in local houses and those engaged in activities overlooking the railway station) emerged as an important issue.

“People feel safer on a station that other people can see” (F2, SF3).

Similarly, when waiting on the platform, visibility of and by others was regarded as inadequate, particularly in the enclosed brick shelters, and respondents preferred the high visibility transparent shelters that they had noticed at some local bus stops.

“Do something about the concrete shelter” (M2, SF4) and “... it’s enclosed on three sides ... it would be better if they had the new clearer ones ... like the bus shelters” (M5, SF5).

Respondents were also asked to rank five modifications which would improve railway stations in terms of their personal safety (see Figure 7).

Clearly, although the VR ‘walk-through’ scenes were filmed during the day, more and better lighting was the most commonly cited suggest improvement being mentioned by 68% of all the respondents interviewed.

“It looks like there could be more lighting there ... it would be almost totally unlit at night” (M2, SF4).

Figure 7. A Hierarchy of Suggested Improvements

CCTV was mentioned by 62% of all the respondents interviewed, despite being in operation at four of the six railway stations.

“The cameras are priceless”(F3, SF6) and “... cameras wouldn’t be able to see inside those brick shelters ... they should have a camera inside” (F3, SF2).

More staff and transparent shelters were also stated by 43% of all the respondents as a positive modification. Cleaner railway stations (38%), longer trains (34%) and cutting back vegetation (30%) were also stated by the respondents in the study and a further fifteen solutions were also mentioned.

“Cleaning up the stations automatically makes it feel a safer place”(M3, SF4). “If you take away those bushes and trees, you could be seen by motorists” (F2, SF6).

Although there are similarities between the male and female respondents there are also significant pluralities of perspective. More and better lighting was suggested by 81% of the female respondents and by only 62% of the male respondents. The same percentage of male and female respondents mentioned CCTV (62%) and significantly, more females (58%) cited transparent shelters than did males (24%). More staff was cited by 48% of male respondents and 38% of female respondents, while cutting back vegetation was a suggestion made by 35% of females and 24% of males. A similar percentage of males and females listed the removal of underpasses (29% and 27%), longer trains were mentioned by 43% of males (27% of females) and better signage by 27% of females (14% of males).

6. Conclusions

The respondents clearly exhibited fears for their personal safety in relation to the railway stations and immediate access routes. In common with previous studies, female respondents exhibited higher levels of fear than the males. Females were particularly concerned about their personal safety when approaching the railway station and while waiting for a train on the platform. Male respondents were concerned with their personal safety at railway station car parks at night and for the security of parked vehicles at night. Respondents generally preferred railway stations that were staffed and where they felt that others could observe them (when approaching the railway station and while waiting on the platform) and which were clean and well-maintained with CCTV in operation.

“It’s nice because it’s open, clean and you couldn’t be approached ... you have clear views all around” (F1, SF2).

The most significant and commonly cited personal safety fears were in relation to railway station environments at night with ‘better lighting’ as the most frequently cited suggested improvement for all the respondents. This was in spite of the fact that the VR ‘walk-through’ scenes of the railway stations and immediate access routes were clearly set in the day. A follow-up study of lighting at Valley Lines railway stations is currently underway with the objective of investigating lighting standards and existing lighting levels at railway stations in an attempt to allay such widespread and specific personal safety fears. Indeed, a recent study has revealed that current street lighting levels may not always be met, and indeed, the standards may themselves require refinement (Cozens *et al.*, 2003). Although at an early stage, as part of its commitment to improve passenger safety, Valley Lines have installed

transparent shelters at seven stations in order to evaluate the perceived effectiveness of this design modification. In a Customer Satisfaction Survey of over 2,000 respondents (Wales and Borders Trains, 2002), 18% commented that they had noticed improvements (which had thus far been installed at only a minority of railway stations). However, at railway stations where the transparent shelters were installed, 93% of respondents stated that they had noticed the recent installation of improvements. Furthermore, of those, 71% felt that transparent shelters enhanced their sense of personal safety due to improved visibility; being able to see around-and-about themselves and also the ability to be seen by others. A more extensive, longer-term study of the perceived impact of design and management changes is certainly necessary to verify the preliminary findings, but the approach adopted and the results thus far seem encouraging.

Significantly, it was recently announced (Wales and Borders Trains, 2003) that over the next twelve months, rail passengers in Wales will benefit from a £2.5m Welsh Assembly Government grant for improvements to railway stations. This funding will allow Wales & Borders Trains to engage with the programme to modernise station facilities and enhance passengers' safety. Welsh Assembly Environment Minister, Sue Essex (Wales and Borders Trains, 2003) stated "this funding will improve essential facilities such as toilets, waiting rooms and shelters, and better passenger safety will be tackled through CCTV and lighting". Indeed, prioritising expenditure on improvements will undoubtedly be a crucial task for the TOCS. Such an approach will also contribute towards addressing the cycle of fear highlighted in Carr and Spring's (1993) model (see Figure 3). Furthermore, the suggested improvements are clearly driven to a considerable extent, by passengers' perceptions which clearly embraces two of the key attributes of Brangtingham *et al's* (1991) categorisation of

crimes against rail users on the system and in and around its immediate access routes (see Figure 2).

This study has demonstrated the value of investigating ‘cartographies of fear’ for different component parts of the selected railway stations and their immediate approaches and also for accessing different rail user groups. Indeed, understanding how certain spatial / design dimensions are perceived by different user groups can certainly enhance both the theory and practice of CPTED. Utilising more dynamic and interactive environmental stimuli represented by the VR ‘walk-through’, can provide ‘subjective’ user perceptions of personal safety issues, in relation to railway stations and their immediate access routes. This can then be analysed in conjunction with existing ‘objective’ indicators for crime (recorded crime rates) and therefore, arguably represents a more holistic approach to understanding the problems of personal safety and fear of crime in and around railway stations. This approach also provides a useful framework for targeting specific improvements at the station-specific level.

In view of the fact the government’s Secure Stations Scheme is not applicable to most of Britain’s stations, train operating companies are therefore required to adopt their own frameworks for creating and maintaining ‘safer’ stations. The utilisation of VR as an environmental stimulus to elucidate user perceptions is certainly an exploratory way forward. However, this study, of a ‘representative’ sample of Valley Lines railway stations, suggests that the development of such technology can potentially be utilised by all those who are responsible for the design, planning and management of railway stations (and other transport systems) in Wales, the UK, Europe and indeed, worldwide.

7. Recommendations

Recommendations for TOCS and managers of railway stations and other transport systems might usefully include:

- Engaging more purposefully with the theory and practice of ‘designing out crime’ and CPTED and utilising such ideas on a site-specific level.
- Collecting, maintaining and monitoring all incidents of crime in and around the railway station, logging all the appropriate details and the *precise location* of incidents of crime in order to potentially modify the design and / or management of such spaces where possible.
- Conducting customer / user surveys relating to where and when passengers may have *experienced* crime and where and when they *feel* vulnerable and unsafe in addition to the collection of data concerning reported incidents of crime.
- Consider utilising virtual reality (VR) ‘walkthrough’ technology to more accurately understand the experiences and perceptions of the users of railway stations (and members of staff) as they might relate to crime and the fear of crime (or indeed, disability, directional information and aesthetics).
- Designing and managing railway stations with the after-dark environment highlighted as a specific and critical issue.

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