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Abstract The objective of this article is to propose an agenda for interventions to prevent or reduce crime and disorder at underground stations in Stockholm, the capital of Sweden. The article first reports the nature, the levels, and the patterns of crime and disorder across time and space. Different types of crime are analyzed and specific conclusions are drawn for each type of crime which relate to the suggested interventions presented in this article. Findings lend weight to principles of situational crime prevention to improve security in transport nodes, with overlaps with routine activity and social disorganization theories. Intervention measures comprehend suggestions on both environmental design related changes and more complex social aspects regarding the reduction of crime at transport nodes. Suggestions for interventions at Stockholm's underground stations, as presented here, constitute an illustration of what can be achieved with situational crime prevention principles; however, they may not be regarded as a "one-size-fits-all" solution to the demands and challenges of safety in transport nodes elsewhere.

Keywords Crime prevention · Offences · Safety · Subway · Transport nodes

Introduction

Crimes cannot be properly explained, nor effectively prevented, without a deep understanding of the environments in which they occur. Nowhere is this more apparent than in urban public transport (Smith and Clarke 2000, p. 169). Transport nodes, such as underground stations, are often characterized as being crime generators and crime attractors (Brantingham and Brantingham 1995). Because transport nodes concentrate heavy flows of people, they may attract offenders searching for suitable targets and locations to commit planned crimes. A crowded station may be an attractive place for theft owing to the opportunities present. Transport nodes are also social spaces, dynamic environments that (unintentionally) generate

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crime situations (e.g., settings where arguments can turn into acts of violence). The dynamic situations at transport nodes also attract offenders and generate opportunities for crime less visible than in other public places. For instance, offenders may be attracted to specific stations because they offer known hiding places. Nevertheless, studies have also shown that some stations may be safer in comparison to other public spaces (e.g., LaVigne 1997). Good planning should involve crime prevention measures that can make underground stations safe for both passengers and personnel by taking into account their nature as crime generators and attractors.

The objective of this article is twofold. First, the goal is to present examples of the nature, the levels, and the patterns of crime and disorder at underground stations, taking into consideration variations across time and space. The work reported here draws on an earlier study by Ceccato et al. (2013), which showed that some stations are more exposed to crime and disorder than others. As discussed in the literature review in the theory section of this paper, the geographical distribution of crime events is related to the environmental attributes of these transport nodes and their geographical context. Then, the article makes suggestions for improving the safety through crime prevention. These suggestions are derived from situational crime prevention, social disorganization theory, rational choice theory, and routine activity principles, as well as from previous studies on transport nodes in the United Kingdom, the United States, and elsewhere (see literature review). Although safety conditions at stations are dependent on multiscale factors (involving the station, neighborhood, and city levels), our focus is mainly on the different environmental features at stations.

Stockholm is an interesting case because it contributes to the international literature on safety and public transport that is dominated by North American and British evidence (but see, e.g., Alm and Lindberg 2000, 2004; Stangeby and Nossum 2004). Moreover, contrary to North American or British cities, the capital of Sweden has been shaped to a large extent by infrastructure planning practices that were a result of the implementation of welfare policies from the 1950s onward. These areas are often lively places where people converge. For this reason, the criminogenic characteristics of these areas may be increased.

The structure of the article is as follows. Relevant literature is discussed in the theory section, followed by the case study of Stockholm. The methodology and results from the empirical analysis are presented in the Method section. The findings and suggestions for action to improve safety conditions at underground stations are presented in the final sections of the article.

Preventing Crime in Transport Nodes: Theory

Transport nodes are places of convergence. They are places that people pass through during their daily routines. They are a point of convergence for many different people who are en route to different destinations and planned activities. An underground station can also represent a place where offender and victim paths converge and, for this reason, where crime may occur. The vast majority of crime occurs within an offender's awareness and activity space (Brantingham and Brantingham 1995). Crime reflects individuals' activities and daily habits, which are rhythmic and consist of patterns that are constantly repeated. Crime opportunities for offenders are created from this repetition of routines and knowledge of daily patterns (Cohen and Felson 1979). Routine activity theory suggests that for crime to happen, there is a need to exist a suitable target, a motivated offender, and the absence of a capable guardian in the same place at the same time. Crime prevention can involve dealing with these preconditions so as to reduce crime opportunities for each of these three aspects. As suggested in crime pattern theory, these preconditions can be dealt with by identifying

crime patterns and tracking offenders' movements and behaviors so as to define the most probable areas for crime events, as well as by analyzing offenders' understanding of spatial environments and crime opportunities (Brantingham and Brantingham 1981). Bernasco and Block (2011) showed that the location of offenders' anchor points is particularly important in defining these patterns and, in fact, relate to higher crime levels.

In short, "crime prevention entails any action designed to reduce the actual level of crime and/or the perceived fear of crime" (Lab 2007, p. 24). This type of action, referred to as *situational crime prevention* (SCP) (Clarke 1995), is grounded in one of the oldest crime prevention approaches—the blocking of crime opportunities. The basics of SCP methods are rooted in opportunities for crime by taking a place-based approach that influences an offender's decision about committing a crime in a specific place (Sherman et al. 1998). The focus of SCP is on suggesting specific, offense-related altering of the management and design of the local environment so as to decrease crime opportunities (Clarke 1997). According to SCP, crime opportunities can be altered by following 25 prevention techniques (Cornish and Clarke 2003). These techniques are based on decreasing opportunities (as outlined in routine activity theory), increasing risks for offenders (as presented in rational choice theory), and managing crime patterns and predicted movements of offenders (as suggested by crime pattern theory) (Brantingham and Brantingham 1981). The techniques used in SCP stem from five intervention possibilities (Cornish and Clarke 2003):

1. Increase the degree of effort for offenders; this includes target hardening, control of accessibility, specific screening of entrances and exits, deflecting of offenders, and security checks for tools and weapons.
2. Increase the risks of crime, which includes extending guardianship, enhancing natural surveillance opportunities, reducing anonymity, utilizing place managers, and strengthening formal surveillance measures.
3. Reduce the rewards for committing a crime, which includes concealing targets, removing targets, marking property, disrupting markets, and denying benefits.
4. Reduce provocations, such as stress and frustration factors, possible disputes, emotional arousal, negative peer influence, and harmful forms of imitation.
5. Remove excuses for crime by establishing clear rules, displaying clear signage and instructions, alerting the conscience of faults, making rule compliance easy, and controlling drugs and alcohol.

It is submitted here that these five intervention possibilities can be used to minimize opportunities for criminal acts at underground stations. The design and layout of a station affect its vulnerability to crime. For example, the design and layout affect a potential offender's likelihood of escaping without being detected (Clarke and Felson 1993). According to rational choice theory, potential offenders evaluate their own risk before making a decision to commit a crime (Clarke and Felson 1993). In this evaluation, the environment plays an important role. Thus, one strategy is to reduce the opportunity for crime by increasing the risk of being caught and decreasing the rewards of committing crime. Both are embedded in Clarke's (1997) SCP approach.

Increased visibility and natural surveillance are key elements of successful crime prevention. Cozens et al. (2003) found visibility to be the most crucial aspect of security at railway stations. A study of Green Line light-rail stations in Los Angeles (Loukaitou-Sideris et al. 2002) showed strong links between crime rates and stations with dark/hiding places or

with poor visibility of the surroundings (the opposite was shown for stations with good visibility). Surveillance can involve, for instance, the installation of closed-circuit television (CCTV) cameras, which from research has shown to have some positive effects on the reduction of robberies and assaults in the London Underground (Webb and Laycock 1992) but produced inconclusive results in the Stockholm subway system (Priks 2009; Ceccato et al. 2013). One topic of discussion is whether the placement of CCTV cameras is not merely a follow-up product in places with known high crime levels. Analyzing the relationship between the use of CCTV and its effect on crime levels is a challenge because it is difficult to know if the cameras are monitored live and controlled, which implies real-time viewing, or computer directed and only used for playback purposes.

Safety relates directly or indirectly to the visibility of passengers—that is, the possibilities of being seen and seeing others (in other words, natural surveillance). Natural surveillance can be defined as the "capacity of physical design to provide surveillance opportunities for residents and their agents" (Newman 1972, p. 78), a central concept in defensible space theory (Newman 1992). Crime prevention through environmental design (CPTED) follows Newman's (1992) basic principles and involves a number of environmental strategies that not only deter offences but also allow individuals to feel in control of their environment. An open layout provides more opportunities for surveillance and control of a place. Orienting housing blocks with windows facing the street creates indirect social control. The creation of softer boundaries between public and private spaces so as to make users of both spaces more responsible for events happening outside their own private space also enhances indirect social control (Newman 1992).

Formal and informal social control play important roles in determining crime levels in transport nodes. Low social control may lead to disorder and physical deterioration. The mechanisms are not well known for underground stations but, according to the broken windows theory put forward by Wilson and Kelling (1982), unrepaired damage to property encourages further vandalism and other types of crimes. A study on the New York subway system showed that the enforcement of quick removal of graffiti also reduced other types of crime such as vandalism and theft (Weisel 2004). This development goes hand in hand with high levels of community social disorganization (Shaw and McKay 1942; Kornhauser 1978) and low collective efficacy (Sampson et al. 1997; Sampson and Raudenbush 1999), which may act as triggers for offenders to commit crimes.

Transport nodes are also influenced by their relative position in a city. Kinney et al. (2008) found that the greatest number of crime incidents is concentrated in and around commercial and civic/institutional land uses; for instance, assault rates in these areas are six times greater than those in residential areas. Research has also revealed that higher rates of violent offenses exist in areas with particular land uses, with high residential and commercial land-use patterns and busy roads being associated with increased crime rates (Stucky and Ottensmann 2009). By contrast, research has shown that a link exists between industrial zoning and decreased violent crime levels. Moreover, in areas with high levels of socioeconomic disadvantage, residential land use had a stronger effect on crime rates than other factors. A relationship seems to exist between the socioeconomic composition of a neighborhood and land-use patterns and their influence on crime levels (Stucky and Ottensmann 2009). Research has also revealed higher robbery levels in neighborhoods (and adjacent areas) accommodating land uses that attract offenders, such as bars and illegal activities (drugs and gambling), where offenders are often around, and that are easily accessible to offenders by, for instance, public transportation (Bernasco and Block 2011). High levels of crime at a station are often correlated with high levels of crime in the surrounding

neighborhoods, which are sometimes triggered by the socioeconomic composition of the population or particular land uses (Pearlstein and Wachs 1982; Hirschfield et al. 1995; Loukaitou-Sideris 1999; Loukaitou-Sideris et al. 2002; Ihlanfeldt 2003; Newton et al. 2004); however, there are exceptions to this rule (e.g., LaVigne 1997). The location of a transport node can be an access point and an attractor for offenders, thereby raising crime levels in the surrounding areas. In particular, transport nodes located in neighborhoods with specific land uses also have higher crime rates in the surrounding areas (Robinson and Giliano 2012). Research has found that in Boston USA, crime incidents concentrate around transit stations in a relatively small area. When the land surrounding public transit stations is used to accommodate event areas (arenas), parking areas, liquor establishments, and residential and green areas, higher levels of different types of crime are found (Robinson and Giliano 2012).

Past and recent strands of Western research on crime geography and crime prevention are used as the basis for this study. It is expected that stations with environments that provide poor conditions for formal and informal social control will tend to be exposed to more crime and disorder than other stations. Moreover, crime follows human routine activities; therefore, significant variations are bound to exist at different times (of the day, week, and year) and stations. The context in which a station is located also plays a role in determining the levels of crime and disorder at the station (Ceccato et al. 2013). It is suggested that for crime prevention to be successful, it has to include a set of interventions that takes into account the surroundings and environmental conditions of the stations and the city context.

The Case of Stockholm's Underground Stations

Stockholm's underground system is composed of 100 stations, of which 47 are underground (mostly central) and 53 aboveground. There are three lines: Green, Red, and Blue (Appendix 1). The main public transport junction is in the central business district (CBD), which is located in the central area of the inner city. All underground lines pass through Central Station, which is the main railway station of the capital. Thus, many travelers and workers pass through this station daily. Central Station is the only station that is connected to all three lines.

To obtain a comprehensive picture of what happens at the stations and in the surrounding areas, three databases were used: Stockholm Public Transport's calls for service, Veolia's personnel register, and police-recorded crime data. The first is based on a reporting database of calls to the central alarm center of Stockholm Public Transport (SL), with most calls being made by passengers and passersby. The Veolia database is based on reports collected from staff (drivers, cleaners, guards, ticket issuers, etc.) working at the (former) contracted organization (Veolia) responsible for running the underground system. The police database is based on records from official police statistics of reported events in an area within 100 m of the underground stations. The uniqueness of using these three data sources is that they provide a view on crime and disorder events from different perspectives (official police reports, as well as personnel and passenger observations). Moreover, the police do not have a complete database of all events that occur (i.e., some events may not be reported to police), nor are all police-recorded events observed and reported by staff and passengers. Therefore, examining all three databases provides a more complete overview of events rather than relying on one database only. Furthermore, the databases represent the different areas analyzed in this paper: SL and Veolia capture events at the stations, whereas the police records are more likely to capture events at the stations and in the surrounding areas (based

on 100-m radius buffers). The police mainly patrol outside the stations and are called in to help in more serious cases or to apprehend individuals who violate the law. Because the databases capture information from similar geographical areas, they are used as complementary sources—rather than as competing sources.

Public disorder is the most common type of event reported at stations, comprising about 80 % of all events. Public disorder at stations includes events that are reported as unlawful activities or anti-social behavior. Some typical examples of such reports are cases of drunkenness and sleeping on trains as well as unjustified use of emergency brakes, fire extinguishers, and fire hoses. Other examples of "irritating behavior" are public urination, littering, begging, drug use, and loitering. The other 20 % of all reported events at underground stations are more serious offenses, often involving violence (including threats), thefts, and vandalism. Most of these serious offenses at underground stations are fights (about 40 %), followed by vandalism and threats, and reports of other types of violence. Most reports of violence are against passengers and guards or other personnel. Threats against personnel are typical events, followed by threats against passengers and drivers. Property crimes at stations are more often recorded by official police statistics than by the databases of SL and Veolia. According to the SL and Veolia data on robbery, most reports are events of robbery of passengers at stations. The police robbery data also show a large number of reports at stations; however, the majority of all records is related to places such as shops and supermarkets located in stations. Theft at underground stations can generally be divided into two types: theft from individuals and of objects at stations. The latter includes theft of bikes and cars, which is not uncommon in the parking lots and streets around underground stations. Theft from individuals mainly involves the stealing of goods from transients and passengers using the underground system. According to the police database, these types of thefts primarily occur at crowded stations. Although police records do not show high numbers, they do record burglary and shoplifting at stations for shops. In this paper, robbery, burglary, and theft are aggregated into the same category of property crimes; otherwise, the number of cases would be too small to assess them individually. However, it would be desirable to work with separate categories for each of these crimes because they require different approaches for intervention. Vandalism is recorded in both databases; the records show events of vandalism, often graffiti and criminal damage to public property, to both stations and trains. The records of vandalism can be discussed in terms of the reliability of the reported time windows for the act as most occurrences are likely discovered at the end of a working day when personnel conduct checks or trains terminate their runs at maintenance areas. However, according to the databases, reports of vandalism on carriages are much less common. For the most part, the reported crimes are related to the stations themselves. Indeed, as with most types of crime, it is hard to define the exact time of the occurrences unless one receives the reports firsthand. Nevertheless, it is the visibility of vandalism, not the event itself, which has the strongest impact on offenders and other types of crime in terms of acting as a provocation and catalyst (see broken windows theory, Wilson and Kelling 1982).

Previous research analyzing the Stockholm underground system reported clear temporal and spatial variations in both crime and events of public disorder (Ceccato et al. 2013). Events tend to happen more often in the evenings/nights, during holidays and on weekends, and, at least for violence, in the cold months of the year. Specific types of crimes also show different patterns: property crimes peak during the afternoon (12:00 noon to 5:00 p.m.), vandalism occurs most often between 7:00 p.m. and 10:00 p.m., and events involving

violence typically happen at night (11:00 p.m. to 3:00 a.m.). Public disorder events generally occur during the afternoon, with increased numbers from 3:00 p.m. to 12:00 midnight. Geographically, the distribution of crime differs according to the type of crime, with suburban stations having higher rates of violence and more central stations having higher rates of property crime (see Ceccato et al. 2013).

Method

Instead of using crude data of events by station from the databases of the police and the transport authorities, rates per 1000 passengers for the three databases and crime types were calculated: robbery, burglary, theft, graffiti, threat, violence, public disorder, and others. Central Station shows the highest number of events in Stockholm; however, after events are standardized by daily passenger flow, Central Station shows a medium-high rate in comparison to other stations. The number of events alone does not present an appropriate distribution because more events will obviously occur in places where more people are around and crime opportunities are higher. Therefore, in order to focus on identifying environmental features of influence on crime levels, standardization by number of passengers is needed. In this case, the so-called "end stations" often have higher rates of events (crime and public disorder) than stations located in the inner city areas, with a few exceptions. These end stations have higher numbers of events related mainly to public disorder; which, according to previous theory, may have in turn an effect on other types of crime. When trains complete their scheduled runs, the end stations often represent the final stop for drunken people on their way home or for disputes that started between passengers while traveling on the train. On a more technical note, it could be expected that passenger flows at end stations are relatively lower than at central stations. Crime and disorder events still occur at end stations, with the rate of event per passenger becoming relatively higher at those stations because of the low passengers flow.

The focus of the present study is on the underground station, which includes platforms, transition areas, lounge areas, and exits. The police crime rates are based on a representation of the station's area that is within a radius of 100 m (roughly representing the size of the station from exit to exit). The "immediate surroundings" are based upon the field of view of about 25 m from each exit. The "surrounding neighborhood" is within a 100 m radius of the station.

The environments of underground stations share some common features (e.g., illumination, gates, real-time train arrival timetables, platform/lounge structures). However, these places are far from homogenous, which potentially affects the stations' vulnerability to crime. To assess these differences, two researchers conducted a systematic and detailed inspection of all underground stations in the Stockholm underground system as well as a check of their surrounding areas over the course of 2 months, spending at least 1 hour at each station. This inspection was at first conducted during daytime hours, between 10:00 a.m. and 4:00 p.m., to avoid rush hour and the darker hours of the day so as to obtain a picture of the stations at "normal operation times." A scaled-down version of the fieldwork was repeated in the winter to check for specific differences during the darker hours of the day (from 2:00 p.m. to 12:00 midnight in winter) and to determine whether winter climate conditions changed the characteristics of the stations' environments.

The features examined by the researchers were selected based on current theories of urban criminology and SCP. The results of previous studies on transport crime have

demonstrated that a number of environmental features, indicators of social control, and socioeconomic variables can influence levels of crime at stations (Table 1). Some examples include the examination of visibility at platforms, as suggested by Cozens et al. (2003); natural surveillance, as highlighted in SCP and rational choice theory; the presence of CCTV, as demonstrated by Webb and Laycock (1992); and mixed land use in surrounding areas, as measured by Loukaitou-Sideris et al. (2002). The attributes were assessed during the fieldwork with a yes/no scale (e.g., presence of dark corners, well illuminated, open layout, social disturbance) or a high/medium/low scale (e.g., crowdedness, visibility, littering). This assessment is, of course, prone to subjectivity; however, a comparison of the results of both researchers showed that the variance was minimal. For example, visibility and surveillance were each checked with a high/medium/low scale by assessing the situation and perception of space from a professional point of view, keeping in mind suggestions from previous studies. The possibility of surveillance at the place was defined as "how well others can see you," thereby taking into consideration a multitude of aspects such as direct view, number of people (guardianship), view from outside toward the place, mirror placement, illumination of the place, and objects disturbing direct view. This definition allowed for a comprehensive and uniform assessment of surveillance. By contrast, visibility was defined

Table 1 Attributes inspected during the fieldwork: a selection

Attributes	Theory
Visibility at the place	Newman 1992; Cozens et al. 2003
Surveillance opportunity	Newman 1992
Objects blocking the view	Cornish and Clarke 2003
Hiding corners	Clarke and Felson 1993
Well illuminated	Cornish and Clarke 2003; Cozens et al. 2003
Presence of guards	Cohen and Felson 1979
Crowded place	Newman 1992
Visibility of CCTVs	Cornish and Clarke 2003
Deterioration	Wilson and Kelling 1982
Presence of café	Cornish and Clarke 2003; Newman 1992
Surroundings	
Number of ATMs	Brantingham and Brantingham 1995
Number of state alcohol-selling outlets	Brantingham and Brantingham 1995; Kinney et al. 2008
Residential area	Kinney et al. 2008; Robinson and Giliano 2012
Commercial area	Kinney et al. 2008
Presence of bars	Brantingham and Brantingham 1995
Presence of guards	Cornish and Clarke 2003; Newman 1992
Presence of bus stops	Kinney et al. 2008
Presence of walking paths	Newman, 1992
Presence of social disorder	Shaw and McKay 1942; Wilson and Kelling 1982
Average income of area (100-m radius)	Shaw and McKay 1942; Kornhauser 1978; Bursik and Grasmick 1993
Population density (100-m radius)	Shaw and McKay 1942; Kornhauser 1978; Bursik and Grasmick 1993

Some features are used in all sections of the station, whereas others are more specific to a particular area (see Ceccato et al. 2013 for details)

as "how well you can see others." Although the definitions for surveillance and visibility are similar, they are not the same. For example, you may be able to notice someone else, but this other person may not be aware or have a direct view of what is happening to you (for additional examples, see Ceccato et al. 2013).

A station's platform consists of the area where the trains arrive and passengers wait, and a transition area is the area between the platform and the gates/ticket window, which commonly includes stairs and elevators to the platform. The lounge is the area before the gates/ticket booth and extends to the exits or tunnels. The exits are entrance areas before the lounge area; they lead directly to a street or via a tunnel to a street. The surroundings include the immediate surroundings around each exit—that is, the field of view from a station's exits. Data from the fieldwork inspection (checklists) were gathered in spreadsheets and then imported to a Geographic Information System (GIS) together with land-use data, crime data, and demographic and socioeconomic data of the population. Stations and crimes were mapped as point data, whereas the Stockholm demographics and socioeconomic data were linked to small unit statistics (*Basområde*) (Appendix 2). To assess the influence of surroundings on crime and disorder events at each station, a number of criminogenic land-use indicators were added to the analysis—the location of automated teller machines (ATMs), schools, police offices, and state alcohol-selling outlets (*Systembolaget*)—in Stockholm.

Bivariate correlation was performed to check for correlation between variables so as to reduce multicollinearity. Regression modeling ordinary least squares (OLS) was tested using 82 % of the Stockholm underground system (i.e., all stations covering the entire municipality of Stockholm) since crime and socio-economic data was available for the municipality only. OLS regression was used to assess how the environment of the stations and surrounding areas (independent variables) affected crime rates (dependent variables). Crime rates (crimes per 1000 passengers) underwent a natural logarithm transformation so as to fit the linear regression modeling assumptions (see Poole and O'Farrell 1971). By using a three-stage procedure, the models first identified variables that significantly (10 % significance level[1]) influenced crime levels at each part of a station (platform, transition, lounge, exits). These results were put together into the model for the whole station, from which the significant variables were combined with variables related to the surroundings. This procedure made it possible to assess the effect of all variables on crime levels, from small-scale environments at the station to the influence of the surroundings (for details, see Ceccato et al. 2013).

Results from the Analysis

In this subsection, some of the most important findings are discussed as a basis for developing suggestions on how to improve safety conditions at underground stations. Table 2 summarizes the results of the modeling for events involving crime and disorder, violence, property crime, and vandalism. However, different types of crime appear to be more specifically related to certain attributes. For violent crimes, the presence of corners was more significant in explaining variations in violence rates, whereas for vandalism, smaller, open layouts and the presence of rough materials were more significant.

Differences in the environment of underground stations has an impact on the stations' vulnerability to crime and disorder. Evidence shows that features that indicate barriers to

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[1] A significance level of 10 % is a common practice in criminology and used here to eliminate the variables that did not contribute to the model.

Table 2 Station features, neighborhood surroundings, and city context

	Variables associated with higher crime rates	Variables associated with lower crime rates
	More corners, hiding places	More people around the station
	Peripheral stations	Good illumination (visibility)
	More ATMs in the surroundings	More CCTV cameras
	Presence of physical deterioration	More police stations
	Higher population density	Lower housing instability

Source: Ceccato et al. 2013, p. 49

formal and informal social control, such as fewer people in the station, objects hindering visibility/surveillance, the presence of out-of-sight corners, and hiding places, are related to higher rates of offenses. Good illumination and a minimal presence of factors that relate to physical and social disturbances are often related to lower rates of crime and events. The context of the stations is also important to the stations' vulnerability; however, the environmental design of the stations remains the most important in explaining crime levels at the stations. The surroundings of some stations help explain some of the variation in addition to the stations' features. Stations with higher rates of crime and disorder are often located in more peripheral neighborhoods (here defined as suburban neighborhoods outside the central congestion tax zone, corresponding to distances of over 5 km from the CBD) as well as in those neighborhoods with higher housing instability, higher population density, and fewer police stations. However, these significant variables and the influence of surrounding environments may vary by the type of crime (Table 3). For crimes involving violence, the model shows mainly an effect of the stations' characteristics—that is, more crime and disorder are found where there are more dark corners in the platform area, more hiding places in transition areas, fewer CCTV cameras in place, transition areas with signs of deterioration, and poor informal surveillance in lounge and exit areas. For property crimes, the situation is the opposite; crime levels are better explained by models that include the surrounding environment. The rates based on police data, which also include events occurring in the immediate vicinity of the stations, perform much better than the ones from the database of SL (station-only events). Variables associated with station surroundings (e.g., open entrances, distance to city center, population density, and presence of villa housing) are all related to high rates of property crimes, according to police data.

Surprisingly, some of the variables depicting the surrounding areas turned out to be nonsignificant or to have an unexpected sign. For example, no effect was found for the presence of schools, nor for the presence of alcohol-selling premises in the surrounding area, as suggested in previous literature (e.g., Block and Block 1995; Loukaitou-Sideris et al. 2002). However, alcohol-selling premises in the present study included only state alcohol-selling outlets, not restaurants and pubs, which may explain the results. Only ATMs showed an effect related to increased violence. The presence of car parks near underground stations also did not show any effect on property crime rates; this finding is unexpected because car parks have a larger number of potential targets for property crime. (For a more extensive discussion of these results, see Ceccato et al. 2013).

Crime and Disorder Prevention at Underground Stations: An Agenda for Action

Because underground stations are an important aspect of everyday life, they should be safe and comfortable for all. Good planning can make daily trips safe for both passengers and

Table 3 Environmental factors affecting crime and disorder and suggested interventions

Problem	Theories	Attributes	Preventive actions
Vandalism	Defensible space	Bad illumination[a]	• Check the quality of illumination in all parts of station premises
	Routine activity	Covered platform**	• Improve visibility and surveillability
		Smaller stations**	• Strengthen formal surveillance
		CCTVs installed**	• Use of graffiti and damage resistant materials
		Rough material[a]	• Make bare walls less accessible
	Broken windows	Deterioration[a]	• Eliminate deterioration and litter
			• Limit graffiti in transport nodes
	Social disorganization	Peripheral location**	• Provide user information and clear rules
			• Improve information and create campaigns targeting specific groups
			• Provide alternatives for legal graffiti
Violence	Defensible space	Low surveillance**	• Improve surveillance possibilities
	Routine activity	Dark corners**	• Eliminate dark places and hiding spots
	Rational choice	Hiding corners**	• Improve winter conditions at stations
		Separate platforms**	
		Better illumination	
	Social disorganization	Peripheral location**	• Manage land use in surrounding areas
		ATMs in vicinity**	• Encourage preventive actions by locals and shopkeepers
		Foreign population in surroundings[a]	
	Rational choice	Less crowded platforms[a]	• Strengthen formal surveillance
		CCTV visible[a]	
		CCTVs installed[a]	
	Routine activity	Deterioration[a]	• Eliminate deterioration
	Broken windows	High visibility	• Separate flows of passengers
	Crime pattern theory		• Train personnel
			• Create safe places for vulnerable groups

Table 3 (continued)

Problem	Theories	Attributes	Preventive actions
Property crimes	Routine activity	High visibility**	• (robbery) Remove hiding spots
		Hiding places**	• (theft) Control access
		Open layout of entrance**	• (theft) Separate flows
		Views on platform from other parts[a]	• (theft/robbery) Strengthen formal surveillance
		Escalators**	• (theft) Make available real-time arrival information to reduce waiting times at platforms and dark/hidden places
	Rational choice	Fewer benches**	• (theft/robbery) Create advantage of seating (promote informal social control)
	Defensible space	Peripheral location**	• (theft/robbery) Eliminate signs that "nobody is in control"
		Villa housing area[a]	• (theft) Clear warnings of possible theft
		High population density	• (robbery) Take charge of 'your own safety' campaigns
Public disorder	Social disorganization	Peripheral location**	• Strengthen formal surveillance
	Routine activity	Bigger central stations**	
		Separate platforms**	
	Social disorganization	Social disorder[a]	• Warn and instruct children and teenagers about behavior and consequences when involved in disruptive acts
		Disturbance[a]	• Inform passengers about consequences of inappropriate behavior
			• Prevent urination on the stations premises by offering public toilets at stations
			• Post information at stations about drink restrictions and food-free carriages
			• Allow for legal performers or buskers on underground premises at pre-determined areas
	Crime pattern theory	ATMs in vicinity[a]	• Adopt a holistic approach to safety through intersectorial cooperation
		Few schools in vicinity[a]	• Have an inclusive approach to safety (avoid group stigmatization)

All variables significant influence (10 % level)

[a] Average significant influence (5 % level)

** Highly significant influence (1 % level)

(Source of "Attributes": Ceccato et al. 2013)

personnel. Simply being aware of crime and disorder at these stations is not enough. The environment and context in which these events occur must be considered, and actions towards improving these environments must be taken. For these actions to be carried out, planners and practitioners should be aware of their role and the challenges involved when working with specific safety issues. They should strive to implement practices that are inclusive and fair (the focus should be on different target groups, and cooperation should be fostered between different actors responsible for different areas and services) and, as much as possible, to work on participatory frameworks. If well thought out, safety interventions and urban planning actions can serve to engage local communities, empower participants, and help facilitate public participation in the production of a safe and liveable built environment.

Suggestions on how to improve safety in transport nodes should not be considered a *one-size-fits-all solution* for the whole transport system or for other underground systems elsewhere. Identifying types of stations (i.e., "typologies") that are more vulnerable to crime (or are perceived as such), as well as considering the contexts in which they are embedded (neighborhood and city contexts), is crucial. Certain stations (e.g., end stations) require more specific surveillance actions against public disorder, whereas some stations require actions to improve environmental design (such as stations with high rates of violent crimes and property crimes). Other stations with high vandalism rates need to focus on establishing and maintaining an image of "in control" surrounding environment (as suggested by broken windows theory). Nevertheless, one station can be part of more than one typology, and one action can be included in several typologies. For example, a station can be included in programs for both surveillance actions and an "in control" environment, as suggested here.

Although transport agencies and other authorities responsible for public environments may not have the power to make structural changes that affect the long-term socioeconomic context of stations (e.g., population density, housing mobility, police patrol programs in neighborhoods), this study offers a number of indications of how environmental attributes (design and land use of stations) may be reconsidered so as to enhance the promotion of safety at underground stations. There are a number of strategies that can be developed to maximize the positive—and to minimize the negative—physical characteristics of particular settings, thereby contributing to greater safety for passengers. These interventions link environmental attributes to current criminological theory (Table 3).

These suggestions are not organized according to priority but rather are linked to the attributes in the third column of Table 3. In the following subsections suggestions for interventions that may help reduce and/or deter acts of vandalism, violence, property crime, and public disorder at underground are discussed in detail. A number of interventions apply to more than one type of crime; these are actions with a broader effect on crime prevention and may provide a different approach to a similar problem according to the type of crime.

Vandalism

Acts of vandalism occur frequently at Stockholm's underground stations (Fig. 1). Vandalism often involves graffiti and criminal damage to public property, both to stations and more rarely inside trains. Damage to trains and stations includes shattered windows, etching, wall graffiti, and other physical damage like damaged benches or burned furniture. It can also involve damage to public transportation properties, including vehicles, shops, and other

Fig. 1 Littering in carriages and transition areas on the weekend; graffiti is one of the most common types of vandalism at underground stations in Stockholm

structures. More than half of these events are related to underground stations themselves, followed by schools and parked private cars near the stations. As mentioned in the case study section, vandalism happens most often in the evenings, specifically between 7:00 p.m. and 10:00 p.m.

The case study in Stockholm indicates that poor illumination at public transport nodes is linked to higher rates of vandalism. Better illumination and see-through walls/windows make offenders feel more exposed, which, according to rational choice theory (Clarke and Felson 1993), negatively affects their decision to vandalize public property. Presented as one of the tools in SCP—that is, as something that enhances natural surveillance opportunities (Cornish and Clarke 2003)—better illumination would increase the risk of being seen while applying graffiti or damaging objects in these dark places. The increase in natural surveillance possibilities may also improve the potential for action by guardians and, according to routine activity principles (Cohen and Felson 1979), restrict the opportunities for offenders to commit crimes. In addition, SCP suggests strengthening formal surveillance (Cornish and Clarke 2003), this will make the risk of detection higher and should, therefore, affect offenders' behavior (Smith and Cornish 2006). Formal surveillance includes an increase in the presence of guards and police officers at stations vulnerable to vandalism at times when vandalism events are most likely to occur (between 7:00 p.m. and 10:00 p.m.).

Transition areas by themselves are vulnerable places for visibility is often low and bare walls/windows are ubiquitous and, thus, attractive for the application of graffiti. Visibility and surveillance in a place are key elements in crime prevention (Newman 1992). Improved opportunities for visibility need to be implemented in transition areas. An investment in design that allows good visibility from outside is desirable, for instance, improved lighting, sightlines and see-through walls/windows. Formal surveillance by CCTV is related to lower levels of recorded vandalism at stations (Ceccato et al. 2013). Smaller stations (with higher vandalism rates) often have fewer cameras installed, and stations with high vandalism rates show less of a CCTV presence. A careful audit should provide information as to where new CCTV cameras should be installed. Because visible CCTV cameras would both reassure passengers and deter potential offenders by increasing the potential risk, their installation should be encouraged in appropriate locations.

More vandalism occurs at stations in which the platform areas are covered by a rain shield and walls consist of rough materials. Rain shields do provide a target for the application of graffiti or other types of damage, and rough materials simply mean that the "work" is harder

to remove and, thus, will be visible longer. As suggested by Smith and Cornish (2006), the application of smooth coatings and the use of specific materials, which make it possible to remove graffiti easily, may result in the "art" being visible for only a short period of time in stations. In this situation, the reward of a longer period of time in which the graffiti is displayed (what graffiti artists aim for) (Cornish and Clarke 2003) is reduced, which makes it less attractive to do at all and may discourage offenders from applying graffiti. Other studies suggest that smooth materials are often preferred by graffiti artists because they are easily workable objects for quickly tagging a place with a marker; however, the application of proper coatings allows the removal process to be quicker and less costly (Weisel 2004). Quick removal in turn slows the rate of general deterioration and has indirect effects on other types of crime. One example of how the quick removal of graffiti results in a reduction in vandalism is the New York subway system, where any graffiti is removed within 24 h (Geason and Wilson 1990). Rain shields should not be removed from stations because they protect passengers and serve their comfort; however, they could be made of damage-resistant material or glass with resistant coating. Another suggestion is the use of plants and thorny bushes in front of walls. By planting vegetation, walls will be less accessible and less attractive to graffiti sprayers. Vegetation also increases the pleasantness of a place, which in turn affects the overall atmosphere and people's moods (Morgan and Smith 2006a).

The deterioration of station environments should be addressed as quickly as possible because it may communicate poor social control at a station and incite offenders (Cornish and Clarke 2003). In accordance with the well-known broken windows theory (Wilson and Kelling 1982), places that are already trashed and littered may influence people to do the same. Preventive actions should be carried out on weekends when stations are plagued by acts of vandalism and littering. So far, SL has already implemented a rapid removal scheme for graffiti and vandalism, which should be intensively continued so as to discourage offenders and let them know that their "work" is not tolerated there and will not be on display long. The Stockholm County Council also keeps a detailed digital record of all reported vandalism in the Stockholm region (Brottsförebyggande rådet - BRÅ 2008). With this record system, graffiti and vandalism can be tracked, resulting in a reduction in the anonymity of graffiti artists, an increase in the risk of detection, and a decrease in rewards (Cornish and Clarke 2003).

Installing signs that clearly state the regulations and penalties in certain spots in stations may make individuals think twice about their actions. These signs should explain that vandalism and graffiti are forbidden at underground stations and that, when caught, one might be fined or have other legal actions follow. The rules for general use of the underground, as well as information about prohibited acts and criminal activities, should be made known to underground users. This displayed information will negate the excuses offenders may find to vandalize a place (Cornish and Clarke 2003).

One alternative way to decrease vandalism may be to provide legal graffiti sites. However, offenders perceive the display of their illegal graffiti in public places as the main reward. Therefore, this alternative action does require coordination with the previous action involving the rapid removal of graffiti and repair to areas of deterioration at other public places. These actions are needed to keep the rewards low and the effort high for illegal public graffiti, resulting in a more satisfying use of legal graffiti sites. For graffiti to become an accepted form of artistic expression requires the free use of walls or buildings for legal graffiti spraying. At present, Stockholm County has a zero tolerance policy toward graffiti. The only exception is "the legal graffiti wall" (*Den Lagliga Graffiti Väggen*) located in the town of Märsta in the municipality of Sigtuna, where graffiti artists can apply graffiti to a

limited area/wall. The wall is popular, especially between March and November when young people queue for the right to paint on the wall. This area has maintenance rules for the environment near the wall so that it can be used by all (for more information, visit http://www.sigtuna.se). Some cities allow graffiti in certain areas (e.g., on the outskirts) but impose limits, such as defining zones that have to be graffiti-free.

In their list of possibilities for SCP, Cornish and Clarke (2003) also proposed alerting the conscience of acts of crime and public disorder, such as vandalism. Campaigns highlighting the responsibility of each individual in contributing to the pleasantness of public spaces should be implemented in schools, libraries, and youth leisure centers, as well as through daily media sources, with a focus on discouraging vandalism and littering. Campaigns of this type, however, require careful planning and a long-term commitment. According to Smith and Cornish (2006), there is a risk of using inappropriate language in these campaigns that may challenge young people to carry out acts of vandalism. The key ingredient for success in such campaigns, they suggested, is to rely on the involvement of multi-actor actions: the school, the municipality, police, other authorities, nongovernmental organizations, and individual citizens.

Violence

Most violent crimes are directed at passengers and are more often reported at stations than on trains. This finding may be an artefact of the recording method used by authorities, which often link events to stations. Violence involving assault (*misshandel*) is the most common event recorded by Stockholm police (70 % of violent acts at underground stations); only a few records are classified as "serious assault." To a lesser extent, there are reports of violence against guards and ticket controllers. As suggested in interviews conducted during fieldwork for this study, ticket controllers at the gates have been insulted, yelled at, and verbally accosted more often recently than they were a couple of years ago. This may be related to the fact that the installation of new electronic gates has made fare dodging more difficult. Violent crime rates, standardized by passenger flow, are highest at stations along the Blue Line and at bigger stations and end stations of the Green Line and the Red Line. This finding may be related to their location in disadvantaged areas and dynamic activity spaces, such as regional centers. As presented in the case study section, violence is most common at night (see also Ceccato et al. 2013). Actions should thus be focused within the time window of 11:00 p.m. and 3:00 a.m.

Stations targeted by acts of violence are usually those with more than one platform and numerous hiding places. In accordance with the defensible space theory (Newman 1992) and SCP (Cornish and Clarke 2003), dark corners at platforms and hiding spots in transition areas need to be checked and, if possible, eliminated. Interventions can include improving sightlines, installing mirrors, and illuminating corners so as to minimize the number of hiding places. Better illumination should provide passengers with better visibility of their environment while waiting for their train to arrive. Transit areas devoid of people are places where passengers are the most fearful; therefore, priority should be given to installing better lighting and improving safety measures in desolated areas (Loukaitou-Sideris et al. 2009). Other measures include the installation of emergency buttons, intercoms, and help points staffed by station employees at targeted stations, which can decrease the time needed to respond to offenses and possibly prevent crimes.

Our findings from Stockholm indicate that natural surveillance, particularly in lounge and exit areas, decreases the possibilities for offenders to stay unnoticed while preparing for an assault and awaiting their next victim. With the creation or improvement of sightlines, passengers can see from afar what awaits them. This action increases the risks for the offender, one of

the main tools in SCP (Cornish and Clarke 2003). Moreover, other passengers or passersby are more likely to notice an offense, and may respond by calling for help or, if unable to make a call, approaching the scene so as to help out immediately. Removing objects that block the view is one aspect of this action. For optimum natural surveillance, lounges and exits should not be covered or sectioned by concrete or brick walls. They should instead provide an open space with glass windows so that the view from the outside is good. Waiting areas at stations should be transparent shelters; the transparency of the shelters improves the natural surveillance in these waiting places. Equally important is the engagement of shopkeepers and locals living in areas surrounding the stations because doing so may increase the number of "eyes on the station," to paraphrase Jacobs (1961).

Our results also showed that increasing formal surveillance—for example, by installing CCTV and having security officers, guards, and police patrolling stations—improved safety. This finding is in line with increasing the risks of crime (Cornish and Clarke 2003) and improving the guardianship role as described in routine activity theory (Cohen and Felson 1979). The implementation of formal surveillance patrols means that immediate action can be taken when a crime occurs and that victims are not left without help when something happens. The presence of guards and ticket controllers makes it difficult for fare dodgers to board a train without valid tickets. Violence may erupt when fare dodgers come face-to-face with ticket controllers. The installation of electronic gates may make it more difficult for a motivated offender to enter a station's platforms without a valid ticket and, thus, serve to protect ticket controllers. Yet, the results of our Stockholm analysis did not show any effect of electronic gates on crime rates compared with older gates at stations (of which a certain amount are still left to date). Nevertheless, in addition to CCTV cameras, the presence of guards and ticket controllers increases natural surveillance opportunities by diminishing anonymity as well as creating a feeling for passengers of always being over watched.

The degree of illumination at underground stations during winter should be investigated and revised. This is particularly important in Scandinavian countries, where daylight may be limited in early mornings and late afternoons (Fig. 2). Improved illumination will aid in enhancing surveillance possibilities and visibility (Newman 1992), thereby increasing risks for offenders (Cornish and Clarke 2003). The conditions of waiting areas are also important. Improved illumination provides better visibility and conditions for surveillance during the dark days of winter. The overall safety and comfort of passengers can be improved with the provision of more comfortable waiting areas; this action in turn makes crowded indoor places seem more welcoming.

Another way in which to help deter violence at stations and in carriages is to provide personnel with clearly defined roles and adequate training. In Stockholm,

Fig. 2 Artificial illumination plays an important role in the perception of places on short winter days with limited exposure to natural light in Scandinavian countries

ticket issuers are not encouraged to intervene in cases of violence because it is the responsibility of security or police to act. In recent years, SL has improved safety for its employees by placing CCTV cameras in the ticket booths at the gates. When we were conducting fieldwork for the present study, we learned from the personnel themselves that the installation of these cameras has substantially decreased harassment and conflicts at the gates. A ticket issuer at a station also remarked during our fieldwork that the emergency courses provided by the transportation agency, which are designed to teach employees how to react and what procedures to follow when harassment and violent events occur, do not always work (personal communication 2010).

The location of ATMs in the areas surrounding underground stations should be reconsidered in Stockholm. According to previous findings, the presence of ATMs in the immediate surroundings of a station increases the chances of violent encounters (Ceccato et al. 2013). Offenders searching for easy targets to rob are often attracted to areas with ATMs because they can easily identify who has withdrawn cash from the ATMs; for this reason, stress levels and the possibility of violent disputes may rise in these areas (Smith and Cornish 2006, p. 97). Installing ATMs inside stations, close to ticket booths, may increase visibility of the palace and indirect surveillance from passengers and ticket issuers. Removing evidence of deterioration will make the atmosphere more pleasant and is especially important for reducing rates of violent crimes in transition areas. According to the broken windows theory, eliminating signs of deterioration will reduce not only the influence on violence and other types of crime (Wilson and Kelling 1982) but also provocations.

Property Crimes

Property crimes are theft, robbery, and burglary. Shoplifting accounts for one-fifth of crimes in the theft category. Robbery includes the robbery of passengers at stations. There are also cases of serious robbery involving the use of weapons; these cases are often associated with the theft of items like cell phones, motorbikes, and clothes. A violent robbery is also classified as an event of violence in the databases if the crime involves serious violent behavior and personal damage; thus, it is recorded as both a robbery and a violent crime. Burglary includes break-ins of shops, cars, and surrounding buildings. Property crimes in the Stockholm underground occur most frequently at stations with larger passenger flows and at those situated in denser and more affluent areas. Intervention measures should be concentrated within the time window when property crimes occur most often—that is, from 12:00 noon to 5:00 p.m. (see case study section).

Strengthening formal surveillance is fundamental to preventing property crimes. Thieves may be less likely to commit theft, robbery, or burglary when they know they are being watched, guards are visible, and cameras are in place. One way to make it more difficult for offenders is to remove hiding spots in transition areas and platforms. The removal of hiding spots will also provide passengers with a more secure feeling. Another way involves installing seats and benches, thus allowing passengers to sit down and easily observe their environment and what is happening around them. This "natural surveillance from a bench" may also increase the effort required to commit theft because potential offenders are probably being watched. Moreover, the increased presence of guards or police elevates the risks of possible arrest, which helps dissuade offenders from committing theft.

Piza and Kennedy (2003) suggested that the accessibility of entrances and exits of subway stations, on the one hand, and the unfamiliarity of passengers with underground stations, on the other hand, tend to increase the opportunity for offenders to commit crime. One way to deal with these vulnerabilities is the separation of flows. Separating passenger flows may make situations less chaotic and less crowded, thus decreasing possibilities for theft. In this type of environment, passengers will be more relaxed and focused on their surroundings, and fewer targets will be available for theft. When an offender behaves differently—for example, by walking in the wrong direction—in this type of environment, passengers are more likely to notice this "strange sight." Moreover, the installation of electronic gates in underground stations means that a motivated offender needs to pay to enter the premises, which in turn increases the costs/effort for committing theft (Cornish and Clarke 2003).

Furthermore, providing real-time information about train arrivals means that passengers do not need to wait unnecessarily in "dangerous" areas, thus diminishing the chances of theft or robbery; in Stockholm, all stations have this feature available. While waiting for a train, passengers should try to stand in well-lit, highly visible places near other people. The provision of real-time information about train arrivals also controls for unneeded loitering on platforms. In general, passengers should keep to well-lit, busy areas around, on the way to/from, and at underground stations. While at a station, passengers should be encouraged to "look alert and act confidently." On busy trains, passengers should keep their belongings nearby and secured. Carrying out these preventive measures may increase the sense of unease that offenders may have about committing crime and in turn decrease their motivation to do so.

As Morgan and Smith (2006b) suggested, providing passengers with useful information about the risks of crime at highly targeted stations makes these stations less attractive to offenders to commit crimes and increases the feeling of safety among passengers. For passengers who wish to park their cars close to underground stations, they should try to park in approved car parks and places that offer opportunities for surveillance. Passengers should avoid deserted places. They should also not leave any items, such as clothes, electronics, and loose change, inside the vehicle which could encourage a break-in. If they have a bike, they should always lock it. When leaving the bike for a period of time, they should try to lock it to something secure (Johnson et al. 2008). People should not leave items such as helmets and other possessions with the bike.

Public Disorder

Public disorder at stations includes events that are classified as unlawful activities or irritating behavior rather than crimes per se. Implementing interventions for public disorder is complex because these actions may not be crimes per se; they are types of behavior that make passengers feel uncomfortable or offended. Nevertheless, there are actions available to control public disorder. These actions should be carried out within the specified time window from 3:00 p.m. to 12:00 midnight at larger stations, particularly at central stations and stations where several transport links (buses, trains) come together as well as end stations. Larger central stations require increased formal surveillance because people frequent there during weekend nights when heading to or from a night out. The presence of extra security elevates the risk of being sanctioned for disorder, as one of the SCP techniques suggests (Cornish and Clarke 2003). When trains complete their scheduled runs, the end stations are often the final stop for passengers who have become intoxicated and/or fallen asleep. Increased attention at these stations is required for dealing with such passengers. Providing proper care is important because drunkenness can complicate matters, leading to irritation, arguments, and, in some cases, violence. Moreover, implementing formal direct

actions, interventions, and mediation of offenders creates a safer atmosphere and reduces provocations (Cornish and Clarke 2003). Reducing the existing potential for acts of disorder and disturbance, which affects public disorder at stations (Table 3), may also lead to a decrease in the levels of disorder as an indirect effect. In the following paragraphs, we put forward some suggestions for reducing actual levels of public disorder.

Clearly posting the rules for underground stations and/or on trips is also important. For instance, rules of what is acceptable in terms of food consumption and drinking in carriages and at stations should also be made known. Regarding alcohol consumption, SL has a zero tolerance policy. Security guards have the authority to confiscate any alcohol being consumed at underground stations. The placement of trash bins in convenient and noticeable locations and the posting of signs encouraging passengers to put trash in trash bins should help prevent littering. Other actions, such as giving seating priority to senior citizens and to pregnant women, discouraging the habit of putting shoes on seats, and enforcing no-smoking bans, should be advertised more often and clearly.

Allowing performers and buskers to work legally on the premises of underground stations and providing them with designated areas inside stations will create a more comfortable and pleasant atmosphere. The passengers will be put at ease with the knowledge that the performers are legally authorized to work there (i.e., the passengers know that they will not be harassed or accosted by the performers). The presence of the performers may also provide natural surveillance. The performers can be provided with instructions on what to do when crime or disorder events occur, thus making quick intervention possible.

A common problem in elevators and exit areas at underground stations is urination. Although not an offense, it affects passengers' sense of safety and well-being. Posting signs of where to find public toilets in underground stations and surrounding areas seems to be more effective than signs prohibiting urination in public places. The installation of free-of-charge toilets, which are accessible to passengers only, at stations along the transport system should decrease urination in elevators and at entrances to underground stations. Although urination may be mainly an act of drunken people, stricter legal actions and higher fines when a person is caught urinating may help in decreasing the problem.

Implementing safety interventions requires cooperation between transportation and security authorities of the City of Stockholm and nongovernmental organizations. By working together, they can tackle issues that are rooted in structural and long-term socioeconomic and land-use problems. A holistic approach involving safety through cooperation must be adopted. In this framework, actions that promote safety must be inclusive because safety is a human right that should be experienced by all. In Stockholm, about half of all reports from underground stations are linked to drinkers/sleeping drinkers. Both the police and partner agencies should continue working together to offer support and amenities to street drinkers.

Although not a new phenomenon, homeless people make use of many public spaces, including transport nodes and surrounding areas. Of the total estimated homeless population population (2892 people) in Stockholm, young people comprise 17 %, and this particular group seems to be increasing (Stockholm stad 2010). The homeless youth population in Stockholm mainly comprises males who have some sort of psychiatric disorder and/or addiction problems (Stockholm stad 2010).

Station personnel, station guards, and police officers should work in partnership with homeless shelters and social care services in Stockholm to provide better possibilities for the homeless. Outreach teams should further encourage the homeless to take advantage of the

help and support offered by nongovernmental organizations, such as *Stadsmissionen*, and from governmental organizations in cooperation with social care services in Stockholm Municipality. Through cooperation, these authorities should endeavor to achieve long-term goals involving better integration of land uses in the areas surrounding underground stations that may become detached from neighborhoods and attract unwanted activities.

Conclusions and Looking Ahead

Underground stations are criminogenic places, but certain stations experience more crime and disorder than others. Previous research has shown that the vulnerability of underground stations to crime varies across space and time as well as type of crime (Ceccato et al. 2013). The present study suggests several actions to improve the safety of stations at specific times for types of crime that occur the most. The study is based on comprehensive fieldwork combined with secondary data sources, regression models, and a GIS. Events tend to happen in the evenings – nights, holidays, and weekends – and, at least for theft, in the hotter months of the year (Ceccato et al. 2013). Results from the modeling show that opportunities for crime are dependent on stations' environmental attributes, type of neighborhood in which they are located, and city context, thus demonstrating the need for a comprehensive, all-inclusive approach. Although these different scales all affect crime levels at underground stations, the environmental features at the stations explain most of the variations in crime types. Features that indicate barriers to formal and informal social control (such as low numbers of people in the station, objects hindering visibility/surveillance, corners, and hiding places) are related to higher rates of offenses. Good illumination and a reduced presence of physical and social disturbance are often related to lower rates of crime and disorder events. As previous studies have demonstrated (e.g., Bernasco and Block 2011; Robinson and Giliano 2012), the context of the stations is also important to the stations' vulnerability. Stations located in more peripheral neighborhoods with higher housing instability and population density and fewer police stations are often targeted to a greater extent by crime and disorder than other stations. However, the significant variables may vary by crime type. Property crimes tend to be concentrated in more central stations as well as stations at the end of the lines. Our results lend support to the principles of traditional urban criminology theory such as routine activity and social disorganization in transport nodes, which define the meeting of a motivated offender and a suitable target in the absence of a guardian (routine activity) and the influence of social provocations and backgrounds (social disorganization) as a basis for criminal behavior. These findings also indicate the potential use of SCP principles in improving safety in these transport nodes with the adoption of techniques that increase risks and effort for the offender, reduce rewards and provocations, and remove excuses for crime (Cornish and Clarke 2003).

   The most important message from this study is that safety at underground stations is a function not only of the local conditions at stations but also the surroundings in which these transport nodes are located. Previous studies had already shown links between higher crime rates in underground stations and specific environmental attributes (Table 3). Thus, authorities should adopt a "whole journey approach" to ensuring the safety of passengers in underground stations. This type of approach was presented by the Department of Transport in the United Kingdom in one of its studies on passenger safety. A whole route approach (i.e., from door to door) was established as a basic requirement for ensuring safe travel when dealing with issues of crime (Department of Environment, Transport and the Regions [DETR] 1999). Authorities' adoption of a whole journey approach may lead to a decrease in crime displacement as the intervention actions have to take into account not only the station but also the surrounding areas.

Thus, implementing prevention measures at stations also involves carrying out prevention measures in the surrounding areas.

Actions should also be based on all stations included in the underground system (i.e., they should not be restricted to the City of Stockholm). Hence, the success of implementing safety interventions will depend to some extent on how well municipalities in Stockholm County cooperate with each other and make surrounding areas safer. This requires better coordination between transport agencies and other institutions responsible for safety in public environments (e.g., the municipality, police districts) not only within the City of Stockholm but also with other municipalities in the region.

Based on her research on the transportation system in Los Angeles, Loukaitou-Sideris (2012, p. 106) suggested that actors should "adopt a multipronged approach to safety" and that the right mix of strategies should depend on the particularity of each setting, the passengers' expressed needs, and available resources. Environmental design interventions should be complemented by policing and neighborhood watch efforts, the use of security technology on transportation premises, the dissemination of information, and the launch of media campaigns. For example, the problems of begging and sleeping at underground stations in Stockholm require actions that are a result of cooperation between social care services in the City of Stockholm and other nongovernmental organizations that specialize in searching for homes (e.g., *Stadsmissionen*) and providing alternatives for shelter, particularly in winter. Another example is the problem of vandalism at underground stations, particularly littering. Actions could be supported by no-littering campaigns driven by schools; this no-littering message could be reinforced in public places, such as libraries and shopping malls, which are often connected to transport nodes in Stockholm.

Are criminologists, urban planners, and practitioners able to ensure a safe journey for all? If so, how can it be done? What can be learned from the international experience and, particularly, from the situation in Stockholm presented here? In the following paragraphs, a number of actions aimed at improving safety conditions at underground stations in Stockholm is suggested. These actions range from easy-to-implement solutions that have a direct effect to long-term structural changes in the area so as to decrease crime levels. The actions that can be implemented quickly and easily mostly involve changes to the environmental design of stations, direct surveillance improvements, and ways to control tidy public spaces.

Adjust Small-Scale Environmental Attributes Priority should be given to the attributes that most substantially influence crime levels (see Table 3). To decrease vandalism, the focus should be on improved surveillance through the installation of CCTV cameras, strengthened formal surveillance at smaller stations, and increased visibility at covered platforms. Efforts to curb violence should concentrate on improving surveillance possibilities and management of land uses in the areas surrounding underground stations through improved illumination; detection and adjustment of dark spots and corners in stations will also improve surveillance. Improving the location and accessibility of cash machines (e.g., installing ATMs in stations instead of in areas surrounding stations) may help reduce crime. In addition, understanding the surrounding social environment can help in identifying local issues that need to be addressed in the long term. In the beginning, efforts to decrease property crime rates should involve enhancing visibility and informal surveillance. Public disorder prevention strategies should focus on prioritizing issues in the areas surrounding stations and improving visibility at the stations themselves. There is also a need to improve platform sightlines and overviews and the ability to create sightlines onto separate platforms from elsewhere and outside the stations.

Improve Visibility and Natural Surveillance at Underground Stations and Surrounding Areas It is important to identify the features of underground stations that negatively influence visibility and surveillance. Measures should then be taken to eliminate these features or to diminish their negative effects. These features include hiding places, dark corners, and poor illumination, particularly in transition areas, lounges, and platforms. Equally important is the presence of people in the stations and in the surrounding areas. Empty streets and desolate public spaces generate opportunities for criminal acts to go unnoticed. Experiences in the United Kingdom and the United States have demonstrated that adequate lighting of streets, parks, bus shelters, and stations can decrease the risk of assaults and the perception of danger (see, e.g., Atkins et al. 1991; Farrington and Welsh 2002; Loukaitou-Sideris et al. 2002). The design orientation of buildings with windows facing the street can increase natural surveillance by neighbors. One design aspect that can improve opportunities for surveillanceis the construction of storefronts that face the sidewalk (Loukaitou-Sideris 1999, 2006).

Eliminate Signs that "Nobody is in Control" and Enhance Pleasantness in Underground Stations Our findings show that physical deterioration is often associated with high rates of crime at stations, which may indicate that the area lacks social control. The elevators of some central stations reek of urine and vomit after weekends and holidays. Creating better signs explaining where to find public toilets at stations or in surrounding areas should be a must in Stockholm underground stations. Incidents of vandalism in transport systems can be reduced through the use of graffiti- and vandal-resistant materials. Equally important is to provide alternatives to public places that can be used for graffiti. Previous research has shown that good maintenance and cleanliness of the public environment at station areas convey reassurance to transport users. City agencies should keep walls, sidewalks, and bus shelters free of graffiti and litter; this action demonstrates that residents are in control of neighborhood public settings and transport nodes.

Long term actions that are carried out in response to the influence of social structures and the surrounding environment on crime levels at stations need to be more societally rooted. Initially, it is important to identify those stations and neighborhoods that are in need of the quickest interventions, thereby setting up a typology of stations. Dealing with these types of situations requires more than a one-time effort; it requires a commitment by authorities to work continually on solving problems as they arise. Furthermore, when making decisions about underground stations, authorities need to take into consideration how these decisions will affect the safety and quality of living of all groups of society, including those citizens who are the most vulnerable (e.g., the elderly and the disabled).

Identify Underground Stations in Need of Intervention Some transportation settings are less safe than others (or, at least, perceived as such), and crime tends to be concentrated in these places. Although end stations are more vulnerable to crime than others, our results show that this pattern may vary by crime type and time (day/week/year). For example, thefts tend to be more concentrated in the hot months of the year, whereas acts of violence occur more often in winter. Targeted interventions should focus on the worst first – that is, the locations with the highest incidence of crime or risk of crime. Detailed monitoring of incident reports – along with regular safety audits by personnel, transport agencies, or other municipal agencies – could provide insight into which stations are most in need of intervention and prevention measures. Checking the social environment can help in identifying local problems that need to be dealt with in the longer term. This can be partly achieved through the establishment of neighborhood activity programs, particularly those directed at youth.

Adapt Safety Initiatives to Particular Needs of Communities and Groups of Individuals Different groups have different needs and run different risks of falling victim to crime while on the move. Interventions should be tailored to the needs of particular subgroups, as well as to the characteristics of neighborhoods and their various transportation settings. It is also important to evaluate whether proposed interventions are reaching the populations who seem to be more susceptible to being victimized or threatened, or may have fewer transport options, such as senior citizens, females, and individuals with disabilities. These populations may include not only passengers at underground stations but also station personnel (e.g., ticket booth workers, guards). Previous research has shown that poor accessibility on the premises of underground stations makes travel for women and for individuals with mobility issues less comfortable and, consequently, less safe (Loukaitou-Sideris et al. 2009). The possibility of adding more elevators for easy access to underground stations—particularly for individuals carrying heavy objects or pushing strollers or traveling with young children—should be investigated in Stockholm. It is a common sight to see parents carrying strollers and/or children while riding escalators; this type of practice poses a danger not only to themselves but also to other passengers, while at the same time it may be the cause of irritation for others. Providing separate spaces for vulnerable groups with mobility disabilities, in particular while waiting for trains, may provide an extra hurdle for offenders.

Based on the analysis of Stockholm's underground stations, several suggestions for safety improvements were put forward. These specific suggestions are thought to be efficient in this particular case for the following reasons:

First, these suggestions are particularly relevant for Stockholm because they are based on empirical results from the Stockholm network itself. Thus, suggestions may not be suitable for other underground network elsewhere. In Stockholm, visibility and surveillance opportunities are of high importance. Since Stockholm is a Scandinavian city, passengers experience extreme differences in weather conditions across the seasons, both in terms of temperature (cold versus warm) and length of daylight (long versus short), which are bound to have an effect on people's routine activity and crime opportunities. Therefore, improving illumination, as suggested here, could potentially have a substantial impact on safety level, particularly during dark, cold winters.

Second, the importance of formal social control may be of particular relevance for the Stockholm case. Guards are already employed at Stockholm's underground stations but not in large numbers. The current presence of safety hosts (*trygghetsvärdar*) and security personnel at underground stations suggests a willingness by authorities to improve surveillance and safety for passengers. The fieldwork showed, during short interviews, that passengers approved and appreciated their presence.

Third, suggestions for well-being in public transportation are generally welcomed by passengers and personnel, which increase the chances of successful interventions. Swedish society generally has a high degree of trust in authorities, thus, information provided by authority personnel is taken seriously and followed up. For example, a large campaign driven by SL was launched in 2012 as a way to thank passengers for their help and to the well being of other passengers while traveling (see http://sl.se/sv/Om-SL/Nyheter/700-tusen-tack/).

Fourth, cooperation between authorities is rooted in the Swedish social welfare system, which is built on policies driven by agencies and local and regional authorities. For the time being, a framework for cooperation does exist. However, the questions that needs to be

answered is how to make it run more effectively to improve the conditions of underground stations and promote a safe public transportation for all.

Further Research

The interpretation of findings should take into consideration that the analysis and suggestions are based on offense data only. Future studies should investigate links between crime and disorder levels and perceived safety so that interventions can also take into account people's perception of the environment at underground stations. In the present study, aspects of visibility and surveillance proved to be important for explaining crime levels. Future research should investigate how these features relate to possibilities of guardianship and to improvements in the capability of guardians at underground stations based on routine activity theory. There is a need to investigate the nature of guardianship when several "guardians" are in place (e.g., passengers, safety hosts, personnel, security guards, and police) and how the possibilities for guardianship are affected by the environment at transport nodes. In addition, the suggested listing of typologies to identify stations that are more vulnerable to crime requires a further elaboration of how to define types of stations in accordance with particular criteria. These criteria can be based on the type of crime or on environmental attributes of importance for those particular stations. Regarding the use of data, a more detailed examination of crime reports is recommended. For example, property crimes could be disaggregated into specific offenses (theft, robbery, burglary) as a way in which to establish specific crime prevention measures for each of these offenses. Despite this limitation, the article contributes to the knowledge base in this area by providing information about the underground system of a Scandinavian city, a research area dominated thus far by North American and British examples.
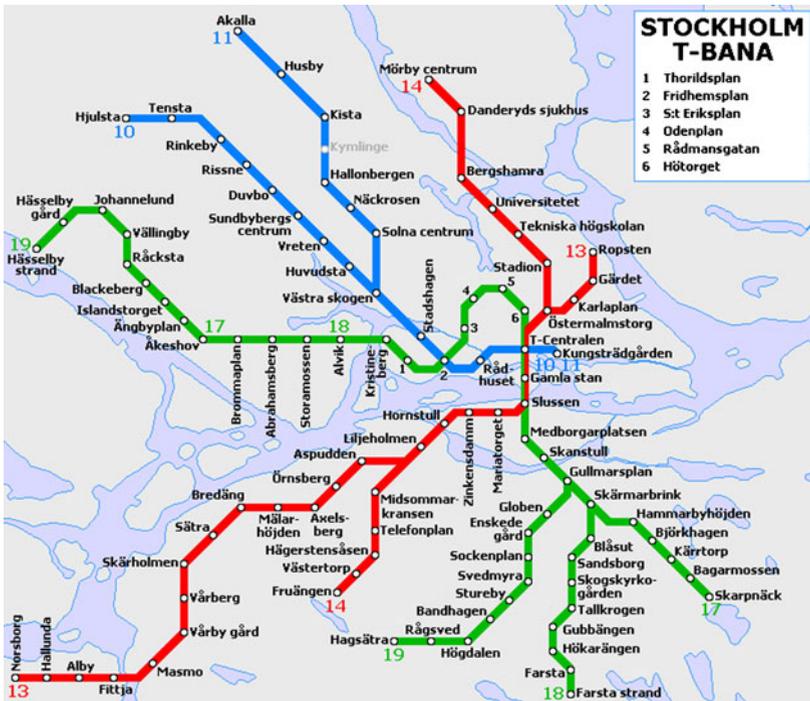
Appendix 1

The Stockholm Underground System

Stockholm is part of an archipelago. The islands are well connected by roads and an efficient public transportation system, comprising buses, the Stockholm underground system, rail systems, and commuter trains. The Stockholm underground system is composed of three lines: Green, Blue, and Red. The Green Line has 49 stations (39 of these are aboveground); it is used by 451,000 passengers per workday, and it is the biggest line in terms of the numbers of passengers and stations. The Red Line, which includes 36 stations (15 of these are aboveground), transports 394,000 passengers per workday. The Blue Line consists of 20 stations (only 1 station aboveground) and transports 171,000 passengers per workday. The trains are operated from 0500 h to 0100 h. All lines have trains running every 10 min during daytime hours. It is limited to every 15 min during the early morning and the late evening,

and every 30 min during the night. During peak hours, additional trains operate every 5 to 6 min in suburb stations, with 2 to 3 min between trains in the central parts of the network (Stockholm Public Transport Annual Report 2006). The underground system is owned by the Stockholm County Council through Stockholm Public Transport (SL), which has contracted operators.

Appendix 2

Table 4 Characteristics of the databases of crime and perceived safety

Databases	Veolia	SL	Police	City of Stockholm	Fieldwork
Time	• 2005–2008 aggregated data by station • 2005 detailed database on hour and date by station	March 2006 to February 2009 detailed database by time and station	2008 police-recorded data by crime type and time	• 2008 socio-economic and land-use data	• 2010 summer and winter (selected variables)
Space	Stockholm underground network (at stations)	• Stockholm underground network (at stations)	• Stockholm City x,y coordinates and buffers	• Data per small unit area (*Basområde*)	• Stockholm underground stations

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