Moving safely
Crime and perceived safety in Stockholm's subway stations

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Vania Ceccato

For Catarina and Regina (in memoriam)

Content of the book

Acknowledgements

In writing this book I am clearly indebted to many colleagues for their contributions, work and comments. Before I start to thank some and perhaps forget others, I will tell the story of how this book came about.

The book started more than a decade ago, when I was analyzing Stockholm's crime geography as part of my PhD thesis. At that time, I became intrigued by looking at a Stockholm map with a number of crime pockets around subway stations. Although subway stations appeared to me as safe environments, I could not stop thinking about them as objects of research every time I used the subway. It was then that I came across a number of studies from the UK and USA that inspired me: Atkins (1990), LaVigne (1997), and especially the studies carried out in California by Loukaitou-Sideris (1999; 2009) and Loukaitou-Sideris et al. (2001; 2002; 2006; 2007; 2009). My ideas also found fertile ground outside the urban criminology literature when I came in contact with the work in transportation by Bertolini (1996) and in the context of safety as a public good by Raws (1971). In 2010, my unpretentious interest in Stockholm's subway stations as criminogenic environments turned into a research project funded by the Swedish Transport Administration with the main goal of investigating crime and safety conditions at the stations. My co-operation with Adriaan Uittenbogaard, as a research assistant, and Roya Bamzar, as a Master student, was fundamental for the development of this research. Both were deep involved in inspecting the subway stations, taking hundreds of photographs of each part of them and talking to personnel and passengers. Roya concentrated on analyzing the data provided by the Stockholm Public Transportation Company, which later became the empirical basis for her Master's thesis. As Adriaan was more interested in the geographical analysis of crime, he analyzed the Veolia's dataset and explored some of the police data too. This book makes reference to this joint work carried on by the group, which has already been published as articles in journals of criminology, geography, and crime prevention as well as presented in conferences.

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Stockholm,
Vania Ceccato

This book contains 34 Figures and 17 Tables.

Chapter 1
Introduction

This book is about safety at transportation nodes; more specially, safety at subway transportation nodes using the Stockholm system as a case study. *Transportation nodes* are places where people come together to (dis)embark on a trip in order to reach a destination. Transportation nodes can be bus stops, subway stations, or larger structures where several transportation modes come together, such as a central station or a transportation hub. Transportation nodes include the station itself but also its immediately surrounding environments (Ceccato 2010). Safety[1] at transportation nodes concerns both the risk of being a victim of a crime and/or feelings of perceived safety at the station itself, as well as on the way to or from it.

Subway stations are chosen as the unit of analysis in this book as they have an absolute, fixed location in space. At the same time, they have the capacity to reflect the dynamics of the city as a whole; they reflect temporal variations in human activities that are regulated by rhythmic movements and schedules of trains, buses, and/or other means of transportation. As transportation nodes concentrate large flows of people, it is easier for offenders to find potential targets. In criminology, stations are often regarded as crime generators and crime attractors, as these environments can potentially pull motivated offenders towards them and provide conditions for crime to happen (Brantingham and Brantingham 1993; 1995). The impact of these environments on safety varies over time as a result of their internal characteristics (physical and social) and as a function of the contexts in which they are imbedded in the city.

The central aim of the book is to provide both theoretical and empirical perspectives on safety conditions at transportation nodes, with particular focus on subway systems. The assumption that an individual has the right to move safely (regardless of the means of transport) introduces the notion that transportation is an integral part of society's basic resources. A conceptual framework for assessing safety at transportation nodes in urban contexts is put forward in the initial parts of the book, and is based on principles from urban criminology theory (social disorganization, routine activity, rational choice, and defensible space).

Safety has both objective and subjective dimensions. If one uses the terms safety and security interchangeably, the concept is rooted in the Latin term, *securitas*,

[1] Safety is, in this book, used interchangeably with security, meaning that it includes both tangible (statistical risk of being a victim of crime) and less tangible aspects (perception of risk of being a victim of crime, overall perceived anxieties). Although in transport research *safety* is often linked to *traffic safety* (e.g. risk for traffic accidents) and *security* is commonly associated with *crime, perceived safety, or terrorism threats* in transport systems, this book restricts the definition of *safety* as a general and comprehensive construct to indicate the risk of being a victim of a crime and/or perceptions of safety.

which means peace of mind, freedom from care, but also freedom from danger[2]. Perceived risk is *the recognition of a situation as possessing at least potential danger which involves exposure to the chance of injury or loss* (Ferraro 1995:8-11), such as the risk of being victimized by a crime or by an accident. The objective dimension of safety has to do with statistical risk, while the subjective dimension stems from a rational and/or irrational feeling that something wrong is going to happen, often leading to the feeling of fear. As Ferraro (1995:24-25) suggests, while risk entails a cognitive judgment, fear is far more emotive in character. Fear is an emotion, a feeling of alarm or dread caused by awareness or expectation of danger (Warr 2000:453). It is therefore true that safety is the antithesis of being or feeling at risk or in fear, but this condition also has connections to a sort of ontological security (Giddens 1991), which relates to an individual's sense of order and continuity in regard to one's experiences in life. Later in the book, tangible and less tangible dimensions of safety will be discussed in relation to public transportation settings. This theoretical framework provides a background for the analysis of crime and disorder, perceived safety, and their temporal patterns.

The book also offers suggestions on how to plan safety at subway stations considering the variety of passenger preferences, needs, and resources. Although these suggestions are not the first ones in the literature, certainly they are new in terms of relying on findings from hypothesis testing and spatial data from a Scandinavian study. The suggestions take into account the need for *a whole journey approach* to safety (door-to-door), both from the perspective of those are responsible for the supply side of service delivery and from those who use the system.

Finally, the book combines principles of traditional theories of urban criminology, crime science, architecture, geography, transportation, urban planning, and gender. It is submitted that safety at transportation nodes is not a field for one science only. Reality demands more integrated and cross-disciplinary theories, as well as methods that are capable of guiding (and dealing with) an ever-increasing volume of data – which constitutes the new frontier of research in urban safety and planning practices. These features make the book relevant for criminologists, planners, architects, psychologists, geographers, as well as professionals dealing directly with safety interventions in public, private, and non-governmental organizations.

What this book does not do is to provide suggestions for safety improvements as a *one-size-fits-all* solution for the whole transportation system, for other types of transportation systems, or as an answer to problems in transportation systems embedded in different demographic, socio-economic, and national conditions. The book draws upon international examples to frame the Stockholm case for two reasons: firstly, to justify why this Scandinavian subway system was chosen for study, and secondly, to show the relevance of the Swedish findings to the international literature. This international background makes the book relevant for ex-

[2] Latin Dictionary and Grammar Aid, available at http://archives.nd.edu/latgramm.htm, accessed 10 February 2013.

perts in safety and transportation research regardless of country, but it is essential to consider the book's suggestions in light of its particular context. The book does not deal with the occurrence of traffic accidents, acts of terrorism, or events of self-harm (e.g. suicides) at transportation nodes[3]. Despite being important areas of research, their generating mechanisms are not the same as the ones behind acts of crime and disorder, which are the focus of this book.

In summary, this book investigates safety conditions at subway stations by adopting an approach that is *place-centered*, taking some distance from the analysis of crime opportunities and criminals. Instead, the book attempts to open up the issue of safety in transportation nodes to a wider audience, by looking upon those who travel through the system, and who may, sometime, become a victim of crime: *the passengers.*

1.1 Chapter Outlines

The book is divided into twelve chapters. This chapter introduces the scope of the book and outlines the contexts of the chapters.

Chapter 2 places the issues of safety and mobility in a general societal context. The attempt is to explain why safety is a relevant subject for those interested in transportation nodes. Of importance are the notions of mobility as an individual right and safety as a public good, and to what extent a lack of one negatively affects the other.

Chapter 3 introduces the concepts of transportation nodes and their relation to the city environment and safety. Safety in transportation nodes is seen to be dependent on multi-scale conditions that act at various levels in an urban environment. Safety conditions at a subway station are determined by the environmental attributes at the station, the characteristics of the immediate surroundings, the types of neighborhood and land use in which the station is located, as well as the relative position of both the station and the neighborhood in the city. The node-place model is adapted from Bertolini (1996; 1999) to discuss stations as multi-scale entities in space and their dynamics as transportation nodes both in time and in the city context. Some of these basic principles have, at least indirectly, been used by researchers both in the U.K. (e.g. Atkins 1990; Smith and Cornish 2006) and USA (e.g. LaVigne 1997; Loukaitou-Sideris 1999; Loukaitou-Sideris et al. 2002; Loukaitou-Sideris 2012).

Chapter 4 reviews relevant theories in environmental criminology that focus on the importance of place as a criminogenic element in the interplay between of-

[3] About suicides in transport systems, see, for instance, O'Donnell and Farmer (1994) and Van Houwelingen et al. (2010) and about terrorism in transport systems, see Swain (2012). Traffic safety is an established area of research in transportation science that involves the performance of a wide range of elements that constitute transportation systems. Thus, any attempt to give examples of published work on this research area would not serve to justify its complexity.

fenders and victims. This spatial emphasis means that to decrease crime, actions to make places safer require initiatives that focus on reducing opportunities for crime to happen at those particular places, in this case, at the subway stations. The literature provides a rich family of crime prevention theories that link environment to crime causation and fear. These theories are discussed as support for the rationale behind the methodology adopted in this study that is presented in the next chapter.

Chapter 5 presents the employed analytic model that combines principles of traditional theories of urban criminology, situational crime prevention and crime prevention by design with the node-place model. Focus is given to the importance of both physical and social characteristics of subway stations in explaining crime and perceived safety. Current urban criminological theories are challenged to guide the analysis of crime at transportation nodes. Theories of fear of crime are also applied to the context of transportation nodes.

Chapter 6 introduces Stockholm's subway system as the study area, with issues of data collection, quality, and availability, and, without being too extensive, with a brief review of the methods used in the analysis. The study area constitutes an interesting case because it is composed of a modern subway system, from which evidence can be used as an example for many large metropolitan areas in North America and Western Europe. There are also special features. The built environment of the capital of Sweden has been shaped to a large extent by planning practices that were a result of social welfare policies from the 1950s onwards. A typical characteristic of this planning philosophy was the fairly wide spatial distribution of the stations over the city, always followed by the construction of a new neighborhood. Subway stations were planned as, and located to be, an integrative part of these new settlements. On one hand, these areas are often lively meeting places where people converge and events go rarely unnoticed by passers-by. On the other hand, the stations' proximities to such mixed land use areas, makes them more criminogenic than their surrounding areas.

The Stockholm case is framed in relation to the international literature on safety at transportation nodes from existent case studies in the U.K. and USA. The empirical analysis of the case study relies on a methodology to assess safety at transportation nodes combining data from fieldwork, surveys, geographical and secondary data from different sources. The dataset is gathered and processed in geo-referenced database using Geographical Information Systems (GIS) and is analyzed using spatial data analysis and modeling. The analysis of the subway stations reported in this book relies on a number of data sources, some of them summarized in reports, articles, presentations, and newspaper articles by the author herself (Ceccato 2010; Ceccato et al. 2011a,b) or in cooperation with Adriaan Uittenbogaard, research assistant, and Roya Bamzar, a Master's student at the time. References to the joint work are made in the chapters, some of the most important are: Ceccato et al. (2011); Bamzar (2010); Ceccato and Uittenbogaard (2012a,b); and Uittenbogaard (2013).

The nature of crime over space and time is discussed in detail in Chapters 7, 8 and 9. Chapter 7 shows that a relatively small share of reported events can be clas-

sified as crime, while most events are rather public disorder and disturbance. Despite the fact that subway stations and their immediate surroundings are criminogenic places, individuals declare that they feel relatively safe there, but are concerned about their safety on the way to/from these transportation nodes. Variations of crime and perceived safety at the station are related to the physical and social attributes of the station's environment, the station's location in the neighborhood, and the city context. How do crime and disorder translate themselves into perceived safety? How do the physical and social environments affect fear of crime at the station? Chapter 8 attempts to answer these questions by assessing perceived safety at the station and in the neighborhood and city contexts. Some of these questions can be better answered by considering the temporal dimensions of crime. Chapter 9 first presents a general discussion of temporal and spatial variations of crime over the urban space and then focuses on temporal patterns of crime at transportation nodes.

Chapter 10 summarizes the results and lessons learned from the Swedish case. The chapter first summarizes some of the most important findings and attempts to integrate them in a wider theoretical context. A number of suggestions for interventions for particular types of crime and focused on Stockholm are put forward in the second part of this chapter, while more generally applicable suggestions are further developed in Chapter 11. The suggestions are written assuming that there is no *silver bullet* that can *solve* the problems of crime and perceived safety at subway stations. But, at the same time, there is no doubt that some attributes of the stations are, more often than others, relevant for station safety; so much so that low report rates of both crime and disorder follow high rates of perceived safety.

Transportation nodes and their surroundings are perfect arenas for local-level intervention. This is because it is at the local level that crime and fear are most felt and expressed. According to UNHSP (2007), although many safety problems cannot be solved at the local level, it is at this spatial scale that the impacts of planning decisions are felt and it is at this level that planning solutions can be discussed. In the case of transportation nodes, the cooperation of multiple actors (including users) in the planning process is fundamental.

There are a number of questions to be addressed in this book. While not all the questions will be properly answered, hopefully these chapters will provide some leads nevertheless. In Chapter 12, the need for a research agenda for safety at transportation nodes is discussed. The proposed research agenda is based on actual crime and disorder events, perceived safety, and the changing role of transportation nodes in the city context. Part of the agenda involves the need for knowledge on actions and interventions to deliver safety at transportation nodes. A relevant question is whether or not criminologists, urban planners, and policy makers are able to apply a whole journey approach to safety at transportation nodes – if so, mapping current challenges faced by actors responsible for providing safe transportation systems is certainly a must in developing a sustainable city. This requires better coordination between transport agencies and other institutions responsible for safety in public environments (e.g. the municipality, police districts,

etc.) at local and regional levels. This final chapter also returns to issues of safety as a common good by posing the question: safety for whom? Those who are less mobile, such as elderly and disabled individuals may not enjoy the same guarantees of a reliable and safe transportation system as the rest of society. The chapter ends with an agenda of issues important to researchers and practitioners alike.

Finally, the book offers a number of definitions that might be useful for the reader to get familiar to this research area and the Swedish case study.

Chapter 2
Mobility and safety

Throughout most of human history, mobility has meant moving people and goods at the speed a person could walk, a horse could gallop, or a boat could be moved by sail. With technological innovations, particularly after the end of the nineteenth century, with trains, cars and airplanes, both the levels of personal travel and movement of goods grew at unprecedented rates (WBCSD 2001). Trains and cars have re-defined the way economic activities are organized in space. Cars made life in the suburbs possible; urban sprawl allowed space for private means of transportation. Equally important was the expansion of modern transport systems with commuting trains and subway systems – a basic infrastructure for the functioning and efficiency of large cities. This increased mobility also meant that more individuals (and things) were exposed to higher risk for adversities, such as victimization by criminal acts.

Safety and mobility are pre-conditions for modern societies. How can they be framed when mobility is approached as a *human right* and safety as a *public good?* In the attempt to answer this question, a number of concepts are discussed in the following sections in order to set the tone for the analysis of safety at transportation nodes as part of cities' sustainability in the next chapters of the book. Instead of engaging in an open debate around differences in approaches that may look divergent at first sight, this chapter simply present them as a background to frame the nature of safety in relation to mobility and sustainability.

2.1 Mobility as a human right

Distance separates people's homes from the places where they work, shop, do business, or socially interact. Mobility enables individuals to overcome distance and access spaces. The geographic dictionary defines mobility as a general term used to describe any kind of spatial movement. WHO (2002) defines mobility as moving by changing position or location or by transferring from one place to another. However, the ability of individuals to be mobile is more than that; it is argued here to be *a human right.*[4] Mobility is about an individual's degree of independence (Peel et al. 2005), the ability one has to take control over one's life and move freely. Mobility is therefore a function of (1) an individual's own ability to claim this right, in other words, to move (e.g. physically, cognitively, economically) and (2) society's capacity to provide conditions for all to be mobile (e.g. public transport infrastructure and services, roads, bus stops adapted for individuals' abilities). In reality, as it is discussed below, these two apparently distinct dimen-

[4] Rights are moral principles that define man's freedom of action within society (Rand 1946).

sions of mobility become fuzzy in conditions of unequal access to goods, transportation, and services.

Individuals' ability to claim their mobility rights depends on their personal characteristics. They may face physical and/or cognitive constraints to move, particularly when using public transportation. The often-called mobility disability includes a wide range of impairments, from very serious diseases or damage to the easier mobility conditions that varies over time (Hanson and Winter 2012). 'Real' (or perceived) barriers of the transport system inhibit accessibility of certain groups who may feel excluded from using the transport system (Church et al. 2000). These barriers have wide-ranging effects on small children, older people, individuals with impaired mobility and those with learning difficulties. According to the Swedish Institute of Assistive Technology, there are 1.3 million people with some form of disability in Sweden, or about 19 percent of the population (2002-2004), which is slightly above both the European (13 percent) and the global (16 percent) average prevalence rates (WHO 2011[5]). It is up to society to offer basic infrastructure that allows individuals to overcome different levels of constraints to movement. The public transportation system, for example, is an important pillar in the Swedish welfare system, regardless of individual ability. Although the car is used much more often than buses and trains in Sweden, one-fourth of all households do not own a car and about a third of the population uses public transportation at least once a week (SIKA 2007). As can be expected, half of the cost for public transport provision comes from a variety of subsidies (two-thirds from the counties, about a third from municipalities, and a small amount from state funding) (Trafikanalys 2012). Interestingly, in the United States, subsidies per public transportation passenger kilometer are double that of Germany. However, in Germany, 8 percent of all trips are made by public transportation compared to only 1.6 percent in the United States (BMVBS 2004; ORNL 2005), which indicates that the amount of subsidies per public transportation passenger kilometer alone is not a good indicator of how society prioritizes public transportation.

Structural economic inequality hampers mobility, but poor mobility contributes to socio-economic exclusion. Although public transportation is clearly the most cost-effective method of mobility offered to all layers of society (UITP 2012), not all individuals have the resources to fully make use of it. In the USA, for instance, low-income households spend one-third of their income on transportation compared to 17 percent for the average household (Pickup and Giuliano 2005). Residents in areas with high levels of social exclusion often lack access to services and other facilities because of time and income constraints affecting their use of transportation services (Leyshon and Thrift 1995; Church et al. 2000). For instance, children in deprived areas have their mobility patterns limited to how much they can spend money on a daily basis, which is thought to affect their life opportunities (Pickup and Giuliano 2005). Leck et al. (2008) show that transportation improvements, especially in the form of introducing new rail links in underserved

[5] Differences in the percentage may be related to varied ways countries define *disability*.

cities, can contribute to the alleviation of spatial wage disparities between core and peripheral cities.

Mobility constraints are not just about economic inequality, but, as suggested by Hanson (2010), are also culturally rooted. Historically, social constructs of 'expected' spatial behavior have created eligibility to access spaces based on age, gender, and ethnicity (O'Brien et al. 2000; Law 1999; Kelley 1996). Public transportation spaces, such as buses and stations, have historically been contested spaces. Perhaps the most iconic representations of these conflicts were witnessed in segregated buses with battles for seats between blacks and whites in mid-twentieth-century USA (Kelley 1996). Gender also produces and reproduces mobility patterns: women with more local and interlinked spatial patterns, often with more use of public transportation (Lundkvist 1998; Larsson and Jalakas 2008), have to adjust to bus and train lines as well as timetables. Women's lower mobility levels remain despite altered gender relations within homes and workplaces. If women are often more fearful (Box et al. 1988; Loukaitou-Sideris et al. 2009), should they judge safety attributes more important when deciding their mobility strategies? The fact that public transportation is not adapted to women's needs creates an extra layer of exclusion for those who are poor:

> We are talking about nothing less than public transportation justice.... As low income women and mothers, they depend heavily on public transportation, and unfortunately there are not a lot of safe places, especially in the evening, where they can wait for the bus; or they cut off service so you have to walk through not very safe neighborhoods to get home. If you work non-traditional hours, you are screwed! (Anita Ress, Associate Director, LIFETIME, quoted in Loukaitou-Sideris 2009a,b).

The impact of modern technologies (Information Communication Technologies – ICTs) on mobility (and personal safety) is a development that is creating interactions that did not exist before, redefining the role of suppliers and consumers in public service provision and perhaps providing new ways for inclusion. As Kakihara and Sørensen (2002) suggest, ICTs provide diversified modalities of interactions adapted to the *uneven and fragmented flows of people, information, objects, money, images and risks across space* (p.4). The implications of ICT for mobility and safety are, at least, promising. For instance, using mobile phones in a subway car to report an act of violence in real time (or to call for an ambulance or even take photos of the event). Interactions like these can have immediate effects for the overall journey of those individuals in the subway car (victim, offender, witnesses for passengers waiting for the train on the platform, for other trains in the network, and for those professionals that are mobilized towards the event (guards, police, paramedics) from different parts of the city. However, Hanson (2000) reminds us that more access to information will only reduce uncertainty (Shannon and Weaver 1949) if the individual is able to place that information into a context and make use of it. For example, receiving real-time information on the platform about a train arrival reduces uncertainty since it allows passengers to better plan their trip and use of waiting time and improves perceived safety. Thus, again, if ICT infrastructure (e.g. broadband, Wi-Fi) is not provided equally across

different societal groups, the exclusion once witnessed by certain groups in the pre-virtual world, pre-G3 phones, etc, will be carried on to the present (and future), at least to those who, for any reason, are not able to catch up with the development. In the next section, inequality in access to service provision is further elaborated, framing safety as a human need that is satisfied according to collectively defined principles of distributive justice.

2.2 Safety as an individual need

A safe environment enables the fulfillment of the most basic individual needs – a safe dwelling and a secure urban environment that allow free movement by all individuals. Needless to say, those living in developing countries still lack a shelter to live in or a bus to take them to school. Although these basic needs are satisfied in many industrialized nations, certain groups of individuals are more often exposed to unsafe environments than others. Some live in polluted areas or neighborhoods constantly affected by environmental hazards; others are exposed to highly violent places. The unequal fulfillment of these basic needs often go together with economic deprivation, lack of jobs, and political negligence that, together with long-term social exclusion, are the roots of fear. If one takes safety as a synonym of lack of crime and fear, then safety is an issue that can be analyzed under the distributive justice framework (see e.g. Rawls 1971).

Distributive justice concerns the fair, just or equitable distribution of benefits and burdens by those living in a society. These benefits (distributive good) and burdens (distributive bad) involve all dimensions of social life, including safety. Crime and fear are *distributive bads* that can be compensated by *distributive goods*, for example, the guarantee of access to public goods, such as having access to reliable and safe public transportation.

In a hypothetical situation, a balance between *distributive goods* and *bads* is desirable only when *goods* and *bads* are fairly distributed across individuals. This means that in the case of safety, better-off individuals run the same risk of being a victim of a crime (or feeling fearful) as worse-off individuals. If one thinks in terms of scenarios, the best outcome for society overall is when a declining crime trend for better-off and worse-off individuals takes place simultaneously (a lower risk of being a victim of crime both within and between groups). Likewise, an increase in crime victimization for all groups, with increasing relativities between groups, is the worst outcome (the risk of being a victim of crime increases for all). In reality, crime victimization is often much more concentrated among the worse off-individuals regardless of context. A relevant question concerning justice is then the following: If an individual has the opportunity to choose between two scenarios, which would be the preferred one?

1. a decrease in crime relativities between groups even if the overall level of crime increases? Or,
2. an overall reduction in the level of crime where the worse-off groups come to suffer relatively more crime victimization? (In other words, increased inequality in victimization despite overall lower crime levels.)

There is no right or wrong answer to this question but the implications of choosing one of these two scenarios are major for society. If an individual were egalitarian, he or she would wish for the first scenario to be true. However, if the individual lives in a utilitarian society, there is a great chance that he or she would prefer the second scenario because having overall lower crime levels (despite unequal victimization) would maximize the general welfare of society. In reality, what often happens is a mix of these approaches. This is because, according to Nozick's argument (in Simmonds 2008), an individual has the right to choose what he or she believes to be fair for himself/herself but *there is a limit to what may justifiably be done to individuals in the name of the general welfare* (Simmonds 2008:93). This means that neglecting unequal victimization among the worse-off individuals is therefore against the notions of safety as a basic need and of the general welfare of the society. Realistically, although victimization will never cease to be unequal among individuals regardless of the type of society they live in, a safe (and just) society might be the one in which individuals see the outcome (e.g. moving safely) as a constant 'goal' to be achieved. Thus, the strategy might be never taking safety for granted even when the share of those who experience safety continually increases.

Both safety and the public transportation system as goods can also be interpreted through Rawls' (1971) lens of distributive justice. The well-off are better protected than the worse-off because the first can afford more *safety products*. The expected consequence is that inequalities in consumption are increased. In an ideal scenario, resources, and therefore the capacity to purchase goods and services, would be evenly distributed across societal groups (Tilley 2012). Thus, in this scenario, if the risk of being a victim of crime were still uneven, this would be entirely because of other crime-causation factors than the victims' own capacity to buy protection. Rawls accepts that if the advantages are accumulated by the better-off, this may also bring improvements to the worse-off. In relation to safety this could be the case. Technological improvements such as sophisticated household safety protection devices tend to start off by being expensive and then become cheaper with mass production. At the beginning, only the rich can afford them. The better-off individuals provide the market and stimulus for the innovations from which the worse-off can take advantage as soon as the product becomes affordable in the market (Tilley 2012).

In order to disentangle the issue of crime and fear of crime as a *distributive bad*, one may think about the construct of safety not as need or an individual right, but instead as something that is between a public good and a commodity. Beatley (1988) has indentified two principles that are relevant here. The first one is the

benefit principle and second is the ability to pay principle. According to the benefit principle, public transportation as public good should be part of investments (either public or private), for example, in new residential areas. The second principle is the ability (or willingness) to pay principle, which means that *contributions to provision of public goods and services should be in proportion of income and wealth* (p. 85), sometimes paid by homeowners, sometimes by the community at large. How do these principles apply to safety? Is safety a public good?

2.3 Safety as a public good

The first action that one might take after a robbery is reporting the crime to the police. It is taken for granted that the duty of local law enforcement is to gather any information that might lead to the offender. Supposedly, this job is to be carried out regardless of whether the victim has paid taxes or not. Safety provision[6], in this case, functions as a public good since protection provided by society is not confined to those who have paid for it. However, the way safety is provided, produced, and consumed in contemporary societies puts in check the idea of safety as a *true public good*. What are public goods?

Public goods are provided collectively because their use cannot be limited to those who are willing (and/or able) to pay for it (non-excludability). Moreover, the consumption of them by one individual does not reduce their availability to others in society (non-rivalry in consumption). For instance, living in a safe city means that citizens, together, can enjoy and share that quality without decreasing its value. However, it is submitted here that safety, as put into practice, does not fit into the classification of a *true public good*. Safety is essentially public in nature, but it does not exhibit all the features of non-excludability and non-rivalry, which are essential qualities of a public good.

From the supply side, the police, despite being the main actor in providing public safety, have lost their hegemony as safety providers. Now the role is shared with many other actors, some being private (e.g. private guard companies), semi-profit organizations (e.g. CrimeWatchers), or even citizens associations (e.g. Neighborhood Watch Schemes). Private interests may not necessarily be against public interests, but they surely have other priorities in a market-oriented economy. In unequal societies[7], security concerns lead to new housing developments

[6] When it is regarded as public security and a result of government actions *to ensure the protection of citizens, organizations, and institutions against threats to their well-being – and to the prosperity of their communities* (Wikipedia, 2013f).

[7] In South Africa and Brazil, for instance, gated communities attend to a large range of societal groups. From exclusive country clubs to low-income fortresses, security is packaged into the product that developers sell and is embedded in housing prices, largely paid by the homeowners themselves. Residents move around the city and may still share other public goods, such as a park. It is argued here that in extreme cases, the need to satisfy the demand for safety creates a patchwork of walled neighborhoods at the price of being able to deliver other public goods, namely elements that contribute to the

(e.g. gated communities) where safety is just a part of the product purchased together with the house and surrounding walls. In such cases, safety as a public good neither satisfies the assumption of non-excludability nor that of non-rivalry in consumption. Only those who have the ability (and willingness) to pay are entitled to the product: to enjoy safety within the walls of these compounds. Therefore, it is argued here that safety provision functions as a *quasi-public good*. Such goods are public in nature, but do not completely fulfill the conditions of non-excludability and non-rivalry. Although the gated community in the European context is regarded as a *failed good* (Goold et al. 2010:19), an urban form that never managed to gain general acceptance, the security industry, in general, flourishes (Zedner 2009). For instance, only those who are able to pay can decrease the risk of victimization through the purchase of household safety protection measures, such as alarms, video cameras, or security locks. Another example is to purchase (or rent) a dwelling in an area that has less crime (or is perceived as such). Thus, the price of *avoiding unsafe places* is already embedded in the total property price (Gibbons 2004; Ceccato and Wilhemson 2011). In transportation, there are many examples of quasi-public goods. For instance, road networks are available to all, but can be made excludable via road pricing for private cars. Also, as soon as the good becomes scarce (i.e. the road becomes congested), there is rivalry in consumption.

Public transportation can also be considered a quasi-public good, since it is a business activity that can be (and often is) privately controlled, is regulated by government legislation (as a public good), and is rejectable, which means consumers may choose to avoid its use (for instance, if fare prices are expensive). In summary, both safety and public transportation may not be *true public goods* in the strict sense, but, as it is argued here, it is not completely appropriate to consider them as pure marketable either. Thus, it is up to each society to define the *right balance* between the market and public dimensions of these quasi-public goods in a way that minimizes the risk of exclusion of various societal groups and provides safe public transportation (e.g. through subsidies).

This might be the reason why Loader and Walker (2007) suggest that security possesses a reflexivity dimension and that the previous conceptualizations are not enough to understand security as a public good. Security has a reflexivity component, which means that its nature depends on those who produce it as a social good. Reflexivity takes place when the observations or actions of individuals in the social system affect the very situations they are experiencing, in this case safety. Thus, in most societies, neither public transportation nor safety provisions are observed as tradable pure commodities in a market economy; they are observed and constructed instead as basic conditions to a collectively defined social necessity.

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city's livability (e.g. environments that are suited for all, roads, street lighting, transport nodes and transportation), which in turn negatively affects overall perceived safety.

2.4 When poor mobility affects safety

Disability is part of the human condition. Almost everyone will be temporarily or permanently impaired at some point in life, and those who live to an old age will experience increased difficulties in functioning. Those who are classified as impaired are far from being a homogenous group. They vary by gender, age, socioeconomic status, sexuality, ethnicity, and cultural background (WHO 2011:3). These disabilities may turn into mobility barriers. The environment has also a strong impact on the experience and extent of disability. Inaccessible environments create also barriers to mobility, for example, a wheelchair user at a station with no elevators, or buses that are inaccessible for the elderly or mothers with strollers. Regardless of the fact that what applies for one type of disability may not apply for others (especially in cases of multiple disabilities), there are some common barriers that are important to discuss here, particularly regarding the role environment plays in the experience of disability.

In Sweden, the most common type of accident among the elderly is falling as a result of slipping, stumbling or tripping in and around the person's own residence (Schyllander and Rosenberg 2010). Poor lighting, clutter, slippery rugs, and lack of handrails are the causes of one-third to one-half of falls (Johnson et al. 2001). Phillipson (2007) also indicates that poor illumination, crumbling sidewalks, and broken stairs, as well as the lack of local relationships, discourage the elderly from using outdoor environment in the U.K. Poor mobility may be indicative of how public transportation lacks the necessary conditions for it to be utilized and enjoyed by all. For instance, one of the most important reasons that a group of elderly in Sweden stopped using buses was the boarding routines (Wrestrand et al. 2009).

The urban environment can also improve the odds for an individual to be mobile. Some minor details of the physical environment can make a big difference for freedom of movement. For instance, in Stockholm municipality, about one-fourth of pedestrian crossings have been rebuilt and improved since the 1970s to make it easier for people with mobility or vision impairments to get about in the city (City of Stockholm 2010). Using active public transportation (trains, subways, trams, and buses) usually involves walking or cycling to and from transit stops, which must also be adapted to allow this movement. Research has shown that walking and cycling are far more common in European countries than in the United States, Australia, or Canada, where the countries with the highest levels of active transportation generally have the lowest obesity rates (Bassett Jr et al. 2008).

Previous studies indicate that elderly persons who live in violent and deteriorated urban environments are more likely to be isolated and fearful (particularly in the evenings) compared with those living in better-off areas. It is often at home or in the nearby environment that the elderly are vulnerable to crime (Aromaa and

Heiskanen 2008) Still, many declare that they are afraid of being the victim of violent crime outdoors.

The fear of outdoor places may also be fed by media reports of extreme cases of sexual assault, such as the one reported by the Associated Press, Los Angeles, USA, in 2012:

> Disabled woman raped on Los Angeles city bus - Los Angeles County Sheriff's officials say they're looking for a man accused of raping a mentally disabled woman on a city bus. The police say that the suspect boarded the bus with the woman in Culver City, followed her to the back of the bus and forced himself on her late Wednesday afternoon. A lone witness tried to alert the bus driver that the rape was happening, but it continued for about 10 minutes until the suspect stopped and exited the bus. The Police say that the 18-year-old woman has the mental capacity of a 10-year-old. According to the police, after the attack, the women reported it to the driver. (Associated Press, Los Angeles 2012)

Stockholm safety surveys have shown that individuals with some sort of disability feel less safe than the rest of the population and that some of them avoid going out in their neighborhood (City of Stockholm 2011), perhaps because of being afraid of something bad happening to them. Fear of being a victim of sexual violence is strong, particularly among women. Although the fact reported above may not be a common fact of everyday life in big cities, it does affect individual mobility, regardless of (dis)ability, and particularly at night. Impaired ability (incapacity to escape and/or react) is certainly of one the reasons why individuals become less mobile.

On-trip information sharing can be a reassurance factor during a trip. ICT has the potential to alleviate mobility barriers by improving the flow of (relevant) information and increasing mobility. Intelligent Transportation Systems (ITS), the integration of ICT in transportation (Sochor 2012), can be particularly effectual as they allow, for instance, tracking and monitoring, which facilitate the collection of movement and activity data, as well as the provision of personalized information. As suggested by Waara (2001), information is a decisive factor in vulnerable users' decisions to travel, especially to unfamiliar destinations. Using a case study case in Stockholm, Sochor (2012) shows that the use of a pedestrian navigation system for visually impaired persons increases mobility and the ability to travel alone and to unfamiliar destinations, and supports the use of general public transportation instead of special transportation services. However, users believe that the navigation system alone cannot be the answer; their mobility should be ensured by other efforts that go beyond technological solutions.

2.5 When safety concerns limit the use of public transportation

One hindrance to an individual's movement is the fear of being exposed to an uncontrolled or unexpected danger, such as being a crime victim. Although public transport environments generate areas of social convergence that are more prone

to crime (Colquhoun 1800; Tobias 1967; Levine and Wachs 1986; Block and Davies 1996; Poister 1996; LaVigne 1997; Tremblay and Tremblay 1998), individuals avoid using public transportation for other reasons.

People who opt to purchase their own vehicle (and have the means to) do so because of the convenience that it offers in comparison with train and buses. Public transportation may not be considered a convenient option for travelling because it is perceived to be too inefficient in terms of timetables, punctuality, and routes (which may not always go to specific locations on smaller streets), especially in less compact cities (e.g. in some countries, less restrictive automobile policies may encourage car use). Public transportation being a quasi-public good means that train, tram or bus fares may be expensive, or at least, not a good value for money. Moreover, in times that praise individuality of consumption, personal space is still an important aspect of an individual's well-being that, for many, is not tradable. For such consumers, safety concerns do not affect their decision to choose public transportation instead of the car since using trains, trams or buses is rarely (or never) an option for them. For whom then, do safety concerns limit the use of public transportation?

Certainly, a large share of the population at least sometimes makes use of public transportation. This share is composed of those who either believe that there are good reasons to utilize public transportation (e.g. it is a more environmental friendly option than a car; it is associated with good health through physical exercise; it may be cheaper than owning a car) or those who do not have a choice other than to rely on public transportation for their mobility (e.g. the poor, the elderly who are no longer able to drive a car, the physically or cognitively disabled). These groups, although heterogeneous, are the ones that are of interest in this chapter. They are the ones that avoid taking a late bus or train for the fear of being assaulted or because they are concerned with the environments they pass on a daily basis as they move between the stop/station and surrounding areas and their home. Regardless of whether an individual's perception of safety at a station is accurate or not, its perception has the power to affect the individual's actions, since what *one perceives as important is what will shape subsequent beliefs and behaviors* (Ferraro 1995:11).

Fear and risk

In the case that an individual's perception is accurate, danger when moving about in the city can be associated with at least two sources: one is related to the features of the transportation system itself that the individual is exposed to (a station, the subway car) and the other is linked to the criminogenic conditions of the immediate environment in which the transportation system is embedded (e.g. a street, a neighborhood). Let's start with the risks related to the transportation system. Evidence shows that public transportation systems in many Western Europe-

an cities are regarded as unsafe places (e.g. Easteal and Wilson 1991; Loukaitou-Sideris 1999; Church et al. 2000; Loukaitou-Sideris et al. 2001; Newton 2004). Transportation nodes (bus stops, rail stations) are often called *crime attractor*s (Kinney et al. 2008) because on one hand, they have the potential of generating crime and disorder by producing crowds, which consist of potential victims (as travelers might be distracted, busy, or tired); and, on the other hand, offenders might be there waiting for them (Block and Davis 1996; Myhre and Rosso 1996). Opportunities for crime may also arise because of lack of surveillance in systems with low flow of travelers (Felson et al. 1990). Regardless of how criminogenic transportation nodes actually are, there is also a consensus that a completely safe journey is not easy to guarantee. This is because an individual might be exposed to a series of complex interactions of settings (buses, trains, and trams), facilities at transportation nodes (stops, stations and interchanges), and people (staff and passengers). Also, as Newton (2004) suggests, the design of these facilities, and the internal (inside a vehicle) and external (the area through which a vehicle or passenger moves to/from the station) environments, may all influence the level of crime experienced in the system.

Moreover, research has also confirmed the importance of the surrounding environment in determining the safety experienced by travelers in buses (Loukaitou-Sideris 1999). Similar findings are reported by Tsai et al. (2011) in Houston in relation to robberies, where the number of bus stops is positively correlated to the occurrence of street robberies together with concentrated economic disadvantage, residential instability, and concentrated immigration. Crime and public transportation are positively related to the intensity of street activity (Angel 1968) but also to large residential areas or areas with transient populations that are attractive to robbers (Bernasco and Block 2009). Offenders select targets at bus stops situated in very busy areas and then execute crimes in places that maximize ecological benefits (Braga et al. 2011). Trains and subway stations are affected by both the physical and socio-economic conditions of the surrounding areas. Lack of visibility in surrounding areas and dark places outside the station is often related to high incident levels at stations. For women, these surrounding areas can be enclosed spaces with limited exit opportunities, anonymous, forested areas, and *interstitial spaces* or in-between buildings that are close to a transportation node (Loukaitou-Sideris et al. 2009).

Fear and individual and multi-scale anxieties

An individual's risk perception may reflect something other than the likelihood of being a victim of crime. Environmental factors contributing to fear include dark environments, poor guardianship, lack of maintenance, physical and social disorder, graffiti, litter, and unkempt and abandoned buildings (Loukaitou-Sideris 2009a,b). Sandercok (2005) argues that expressions of fear of crime are actually

expressions of fear of difference; in other words, fear of others (see, e.g. the perception of the homeless in Bucharest in Paraschiv 2012). Researchers have also associated fear with one's own individual characteristics, such as, age and gender. For instance, in the UK, only about 30 percent of men declare feeling unsafe in transportation settings after dark, versus 60 percent of women (Crime Concern 2004). The places where one feels unsafe also varies; while women fear multi-story parking structures most, men fear waiting on underground station platforms. Fear also reflects an individual's abilities and vulnerabilities (e.g. level of physical ability). For instance, individuals with disabilities are more likely to fear being a victim of crime and feel unsafe when travelling alone in their community after dark, perhaps as a result of greater perceived inability to fight back if attacked (Loukaitou-Sideris 1999; Yavuz and Welch 2010). Jackson (2004) suggests that perceived safety reflects both *experience fear* (the summation of the frequency of emotions) and *expressive fear*, which involves individuals' perceived vulnerability and broader social attitudes and values.

There are potential local and global dangers that mediate fear and vulnerability in modern societies. These potential dangers are, for instance, triggers of social exclusion that lead to fear and limit mobility, such as the risk for sexual assault or mugging, but also fear of falling sick, losing a home or job, or rare events, such as being a victim of terrorism. The conviction that a societal safety net will *not* be in place if something happens may lead individuals to take extra precautions. For instance, police corruption leads to low crime-reporting rates since individuals, if victimized by a crime, are skeptical about society's capacity to protect them (e.g. Los 2002; Pain 2009; Day 2009). The same applies to women's experiences, particularly in societies with high gender inequality, since they rarely get the support they need in cases of sexual assault (Whitzman 2007).

In summary, whether the risks of danger are 'real' or not, the effect is the same. Individuals do not see public transportation as an alternative and, in extreme cases, become less mobile, which is evidence of functional fear (Jackson and Gray 2010). In this case, constrained behavior might be adopted, e.g. by staying away from certain places in order to minimize exposure to potentially dangerous situations (Foster and Giles-Corti 2008). At the individual level, this extreme type of fear that affects behavior becomes a barrier to individuals' physical activity and good health (Miles and Panton 2006; Eyler et al. 1998).

At the collective level, fear creates borders between social groups and neighborhoods (Caldeira 2000; Landman 2005). Researchers argue that the opposite is true: group isolation and individuals' deliberate place avoidance also creates fear and suspicion (e.g. Pain 2010). Decreased mobility harms social interaction, which in turn makes individuals even more isolated. Fear, therefore, affects the health of the community, e.g. long-term, mutual trust, social cohesion (Riger et al. 1981; Garcia et al. 2007) and social sustainability. The next section discusses how safety is essential to urban social sustainability.

2.6 Safety and mobility in sustainable cities

Researchers and urban experts have long recognized safety as an important challenge in creating sustainable cities. For instance, in The Montreal Declaration, the International Association of Public Transport declares that:

> Mobility is a basic requirement for efficient and modern cities. No city today can function efficiently without a public transit system. Public transit is a recognized part of the solution towards achieving economic prosperity and livable cities in the face of challenges such as climate change, congestion, as well as safety and security. However, in today's context of crime and terrorist threats, ensuring the safety and security of passengers is increasingly challenging. (UITP 2009).

A sustainable city is a place where safety provides the basis for a wider sense of place attachment and free movement, regardless of space and time. Although the original definition of sustainability contained social, economic and environmental components, Greed (2012) argues that there has been an overemphasis upon the environmental aspects at the expense of social considerations. This is particularly relevant when more and more individuals chose public transportation as a way to move around in the city. Recent statistics show that ridership has increased steadily in many countries over the last decade. Between 2004 and 2008, ridership rose by about 11 percent in Spain, the U.K. and USA. During the same period, cities such as London and Brussels recorded particularly high ridership increases (around 20 percent). In France, excluding Paris, the number of passenger journeys increased by about 12 percent between 2006 and 2008 alone (UITP 2012). Sweden is no different. Since 2000, the number of trips made per inhabitant and year has increased by 18 percent (Trafikanalys 2012). Still, individuals may face a number of constraints that impair their movement. Lack of safety is one of them. If passengers are in fear, they may avoid buses at late hours if they are perceived as dangerous. If neither mobility nor safety can (yet) be attained by all, the question is: *mobility and safety for whom?*

Having detailed geographical knowledge of a city's criminogenic conditions is important in the debate on urban sustainability (Ceccato and Lukyte 2011), just as it is in this book. Knowledge about different levels of crime at transportation nodes, for instance, provides a guide for targeting crime where it can have the most impact, from dispatching and community policing to offence analysis and resource planning. Each of these tends to operate on different geographical scales, involving different actors (e.g. police officers, planners, and community experts).

Equally important for urban sustainability is perceived safety. It would be easy to assume that fear of crime perfect fits with the geography of crime, but rarely it does. There is a general consensus that fear is more than a function of risk of and actual experience with victimization (Jackson (2004). Therefore, interventions to improve safety conditions in urban environments have been shifting from design-based interventions to more holistic approaches, which emphasize the role of communities and special groups in ensuring safety (Ceccato and Lukyte 2011).

Drawing from evidence from the British context, Greed (2012:219) believes that sustainability-driven planning policies *are working against inclusive, equitable and accessible cities...sustainability policy is set at too high a level to engage with the realities of everyday life*. This is the challenge: How can environmentally, economically and socially sustainable cities be planned to take into account the needs of special groups without being exclusionary? Perhaps the answer to this problem has to be framed as new questions, some of which deal with how society can directly contribute to the process of defining policies that lead to more sustainable forms of consumption and just lifestyles. For example, Greed (2011) reminds us that if governments intend to shift from private car use to public transportation, not only is a major urban infrastructure investment required, but there is also a need to restore street-level facilities. Others challenges require a clearer definition of the roles of public and private actors in providing quasi-public goods, such as transportation and safety; also, a better understanding of the practical roles of environmental organizations and governments in balancing all goals of sustainability at various spatial scales (local, regional, national and supra-national) when delivering public transportation and safety. Regardless of the answers to these questions, a focus on more inclusive forms of sustainability, including gender-informed initiatives as well as environmental and technological solutions (e.g. ITS) directed to individuals with different types of disabilities, could open up new ways of thinking about mobility, safety and urban development.

In the Swedish context, despite clear advancements since the 1990s, challenges remain (City of Stockholm 2010) particularly for those who use the city under different conditions than the established ones: the traditionally recognized groups of disabled (e.g. the blind and other physically or mentally impaired) and the newly recognized ones (e.g. elderly, women, children, and newly-arrived immigrants who lack the language skills to understand signs and the local transportation system). This process also demands adopting a fair and egalitarian perspective towards individuals by those who plan and build the city and provide services (Whitzman 2008). In other words, the process requires *a good urban governance*. According to the United Nations Development Programme, good urban governance is *efficient and effective response to urban problems by democratically elected and accountable local governments working in partnership with civil society* (UNCHS 2000). Chapter 11 shows examples of how in Stockholm safety in transportation nodes is ensured through cooperation of actors working in initiatives at national, regional and/or local scales. Some of them are under community safety frameworks with the police and local crime prevention councils while others are driven by initiatives from the county, municipality (spatial and transportation planning agencies), private companies as well as NGOs. In the next chapters, a theoretical framework provides the basis for the analysis of safety at transportation nodes, which is interwoven with sustainability goals throughout the book. In the final chapters, sustainability once again becomes a clear part of the agenda, but this time from the perspectives of suppliers and users.

Chapter 3
Transportation nodes and the city

3.1 The node-place model

Subway or railway stations are considered to be transportation nodes in this book. In transportation literature, a transportation node has been defined in different ways. Transportation nodes are synonymous with stations, transportation hubs, a focused place linking different means of transportation (e.g. train, buses, airplanes, ships) (e.g. Guimera et al. 2005; Ducruet and Notteboom 2012). Transportation nodes have multi-dimensional features. As Bertolini (1996) suggests, today's station is certainly more than *a place where trains arrive and depart*. Previous definitions miss, for example, the growing roles of other forms of transportation. Neither is it appropriate to call a station a *transportation interchange*, as this definition does not make reference to the distinct urban context in which the station is embedded. A more satisfying solution, the author suggests, should take into account the fact that stations are, ambivalently, both *nodes* and *places*, nodes of networks, and places in the city (Bertolini 1996 in Peek et al. 2006:444):

> Station areas are important nodes in both transport and non-transport (e.g. business, consumption) networks. Station areas characterize a place. They are both permanently and temporarily an inhabited area of the city, a dense and diverse conglomeration of uses and forms accumulated through time, which may or may not share in the life of the node.

This definition is relevant since it has a number of implications for the station as a criminogenic place. First, station areas are places of convergence. They are linked to human activities that are regulated by a rhythmic schedule of buses and/or trains. Therefore, they have the capacity to reflect the dynamics of their surroundings and, together with other transportation nodes, they mirror the flow of people across the city as a whole. They concentrate large flows of people, which for instance, make it easier for motivated offenders to consider committing thefts as at a particular time.

The assumption that station are both nodes and places implies that crime and perceived safety at a station is a function of both the internal conditions of the transportation node (physical and social environment) and the external infrastructure, services and activities that it may contain. This interdependence between stations services and surroundings composes what is experienced by passengers as (un)safe. It is reasonable to expect that when the station's surrounding areas are perceived as pleasant and safe, individuals will use them even when they are not there as passengers (e.g. for the services they may provide).

Although they can be seen as a unit, the node and its surroundings have very different functions in city life which and may work independently. While services and products may be found elsewhere in the city (e.g. coffee shops), those found

in that particularly transportation node are unique, at least with regards to their geographic location, personnel, activities. Selling transportation tickets and other related services offered at these nodes do not necessarily compete with services and products found in the surrounding areas, such as those services provided by banks, restaurants, hotels, and stores close to the station. These differences are criminologically relevant since they will affect the crime make-up of both the node and the surrounding area.

Since the node and station area have different functions, they may attract people at different times (not necessarily the same groups). As suggested by Hägerstrand (1970), accessibility to places is limited by space-time constraints. While the service supply in nodes (e.g. subway stations) may be open all night, banks and flower shops may only offer their services and products during commercial hours. From a criminological perspective, the rhythm of activities is relevant to help interpret variations in the levels of targeted groups' victimization (e.g. disorder, drinking and assault during evening hours), but also sudden low/high concentrations of crimes (for instance, at the stations after midnight, when bars and restaurants are closing). Regulated by calendric and seasonal changes, space-time constraints define the variations in human activities over the course of the year. Individuals' activities and daily habits are rhythmic and consist of patterns that are constantly repeated; moreover, most crimes depend on the interrelation of people in space and time. As suggested by routine activity theory (Cohen and Felson 1979), crime depends on the offenders' motivation, presence of suitable targets (victims), and absence of responsible guardians.

Simultaneously regarding a station area as a node and place also has a long-term effect on the area (and its safety) over time. For instance, *improving transport provision in a station location will, because of improved accessibility, create conditions favorable to the further intensification and diversification of activities in the area* (Peek et al. 2006:445). Thus, if accessibility is improved, it could be expected that safety conditions (e.g. opportunities for crime) may change both at the node and in the surrounding areas.

The integration of nodes and places requires the integration of actions of many actors. According to Peek et al. (2006:444), a numerous *array of both node- and place-based actors crowds station area development processes* (e.g. local government, the subway or railway company, local residents, businesses). Their interests are often *heterogeneous, conflicting and, at best, uncoordinated*. It is submitted here that safety interventions at a station are therefore dependent to some extent on how well actors can cooperate with each other and make both nodes and surrounding areas safer. This requires coordinated actions between individual actors in the form of transportation agencies, municipalities, and private sector and other institutions responsible for safety in public environments.

3.2 Safety and the node-place model

The theory put forward and discussed in this section is an adaptation of the so-called *node-place model* proposed by Bertolini (1999:201) and revised in Peek et al. (2006:445-6). The model is illustrated by Figure 3.1a in which:

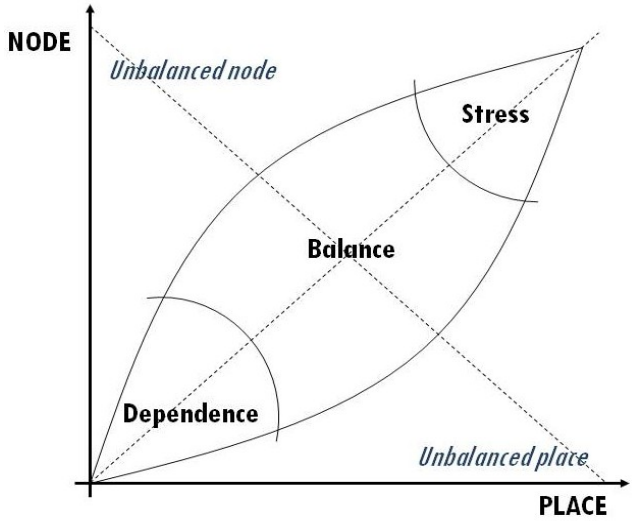
> …the ***y*** value corresponds to the node-content of an area, or to the accessibility of the node, and thus to its potential for physical human interaction (the more people can get there, the more interaction is possible). The ***x*** value corresponds to the place-content of an area, or to the intensity and diversity of activities there, and thus to the degree of actual realization of the potential for physical human interaction (the more activities are there, the more interaction is actually happening).

The original model does not make any reference to safety issues. In this chapter, the model is further developed based on traditional urban criminology theory and principles of situational crime prevention. The typologies can be helpful to interpret different types of stations in different urban locations and their vulnerability to crime as well as their perceived safety. The node-place model and related urban criminology theories underlie the discussion of the Swedish case study presented in the next chapters.

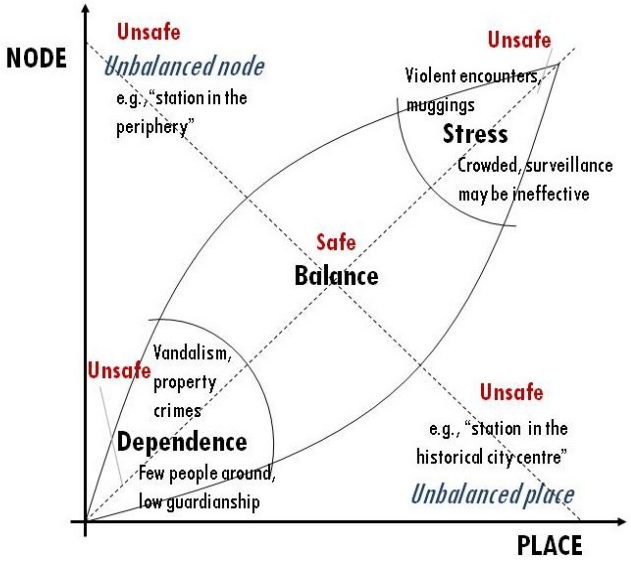
The node-place model suggests five hypothetical situations (Figure 3.1a,b). *Balanced* locations are found along the diagonal (top-right to bottom-left), where node and place values are equally strong (the entire 'eye'-shaped section). It is along the diagonal that there are *balanced* locations, where node and place values are equally strong. It is submitted here that these are the stations where both crime and fear of crime are kept under control. Both the size of the node and the extent of services allow for natural surveillance that can be facilitated by the physical and social environments of both the station and surrounding areas.

To the top-right are areas *under stress*, e.g. the stations are often crowded; central stations often fall in this category. In this corner, the intensity and diversity of both mobility flows and urban activities are maximal (both node and place are strong). However, these are also locations where the great concentrations of flows and activities mean that there is an equally great chance of conflicts between multiple claims on the limited space, and that further grow in flows and activities might become increasingly problematic. Despite the flow of passengers, natural surveillance is not always possible because the flow is so intense that the passengers are too close to (and unaware of) each other to see what is happening. Corridors and entrances may accommodate illegal street performers that may function as guardians of the place, but may also distract passers-by. Although benches might be present, they are not enough for those in need; those waiting for the train may sit on the floor, tables, or similar areas where they may also place their luggage. Passengers may stand close together in front of information screens, with little awareness of pickpocketers. Some of these passengers do not know well the system, e.g. tourists, and may become easy targets due to exposure to unfamiliar places while waiting for the train. As trains frequently pass by, people are not will-

ing to intervene if anything happens; they may not be even aware of thieves on the platform or in the elevators.



(a)



(b)

Figure 3.1 (a) The original node-place model. Source: Bertolini (1999), and
(b) Criminogenic conditions according to the node-place model.
Note that the ***y*** value corresponds to the node-content of an area, or to the accessibility of the node while the ***x*** value corresponds to the place-content of an area, or to the intensity and diversity of activities.

When the station is overcrowded, conflicts may arise and be visible for other passengers. These types of stations may be particularly vulnerable to acts of disturbance and violence during weekends and long holidays. Both formal and informal social control has important roles to play in determining crime levels at these types of transportation nodes. The station's adjacent parking lots may attract burglars that may steal valuables from cars. In city centers, thefts at parking lots may go hand in hand with high levels of social disorganization (Shaw and McKay 1942; Kornhauser 1978) and low collective efficacy (Sampson et al. 1997) in the station's neighborhoods. The intense flow of passengers can be linked to littering and physical deterioration, which promote the notion of low social control.

At the opposite corner (bottom-left) is another typical situation, represented by *dependent locations* where both node and place are weak. The demand for transportation services is so low that supply can be held in place only through the intervention of other factors (e.g. subsidies). Isolated urban and/or small-town stations often fall in this category. Since the demand for transportation services is low (unless trains are arriving or departing), very few people are found at the station, which generates little potential guardianship of the station property, passengers, and their belongings. Physical damage (vandalism), public disorder, and property theft may be particular concentrated at these stations (in relation to the rest of the city and other station types). The levels of crime are relatively lower at these stations compared to stations under *stress conditions*.

There are two other *unbalanced* extremes – an unbalanced node and an unbalanced place. The first case (*unbalanced node*, top-left) could be a newly opened station on the urban fringe. The development of a new station leads to other types of investments in the surrounding areas that generate new land uses. Since land use determines both the activities found in an area and the composition of the population at any given time (Wikström 1991), shopping areas around a transportation node may attract temporary populations who are at high risk of being victimized by pick pocketing, shoplifting, various types of thefts, and, at certain times, violence. These groups are sometimes the ones that offend and get involved in opportunistic acts of violence and disorder (Dunning 2000; Stott et al. 2001). An *unbalanced node*, such as a newly opened station on the urban periphery, might face similar criminogenic conditions as a *dependent* node, not because it is relatively weaker as a node, but because it might be too isolated, with seldom used surrounding areas. A new transportation terminal may have a direct effect on crime patterns by creating a new site for offending or by altering patterns of *routine activity* by motivated offenders (Cohen and Felson 1979; Ceccato and Haining 2004), but also by being seldom used, which promote fear because of poor guardianship (Atkins 1990). Cars (and objects in the cars) parked for long hours in *Park and Ride* lots might become easy targets for thieves. Main roads around the station reduce the already low natural surveillance to a minimum. Forests and green areas may reduce visibility from residential areas near the station. Nearby outlets attract visitors, but only during commercial hours.

The second case (at the bottom-right of Figure 3.1) is the *unbalanced place*. This type of station is relatively difficult to access and, although the area is commercially well-developed, the transportation node may be not be. Stations located in historic centers tend to fall into this category. Typical touristic surrounding areas, especially those geared towards pedestrians. More people do not mean better safety conditions through guardianship. According to Brantingham et al. (1991), offences occur where criminal opportunities intersect with areas that are cognitively known to a motivated offender. These areas create impersonal spaces that bring together different social groups, attract motivated offenders, and create opportunities for crime (see, for example, Levine and Wachs 1986; Atkins 1990; Block and Davies 1996; Poister 1996; LaVigne 1997; Loukaitou-Sideris 1999; Loukaitou-Sideris et al. 2002). Bars and restaurants keep the area alive 24 hours a day. Streets may be noisy and place for violent encounters in the hours of the morning.

Neither nodes nor places at the four extreme corners of the diagram are characterized as natural examples of safe environments. Depending on the surroundings and neighborhood composition, nodes will be perceived as more or less safe. Levels and types of crime will determine personal safety levels at the node and on the way to or from it. Crime risk is important, but equally relevant is perceived safety in public transportation since it also affects individuals' general perceptions of the city's livability and their access to jobs and services.

Limitations of the node-place model

The node-place model is, as suggested above, helpful in providing a theoretical framework for systematically relating transportation nodes to the urban environment. It is instrumental in illustrating the need to consider the interaction between the conditions at the node and those that characterize the place in which the node is embedded. To some extent, it highlights the need to regard the characteristics of a station in relation to the larger, hierarchical transportation system. Both of these qualities are important to support the interpretation of transportation nodes and the surrounding areas as criminogenic (and unsafe) places.

The model is, however, not free of limitations. One of the limitations is that the model does not consider the importance of the physical and social environments at each station (or its surroundings). This fact, per se, may have an effect on the success of the station as a node. If the station is perceived as safe, investments will be attracted to it and its surrounding areas. In a hypothetical example, a *successful* station explores its modernistic features with natural light and glassy windows, which, indirectly, encourage natural surveillance onto different platforms over the course of the entire day. An *unsuccessful* station, built at the same time, feels outdated and unsafe due to dark corners, particularly at the entrance/exit areas.

Another limitation is that the model does not consider the space-time dimension of a transportation node. The two stations in the hypothetical example above

are influenced by similar surroundings, but one has high crime rates and the other low. What does make them different? By scrutinizing their surrounding environment one notices that they are not as similar as initially thought. One of them offers stores that operate around-the-clock and attract social interactions during the evenings and nights that often lead to crime and disorder. Although the immediate neighborhood looks the same, the unsafe station ends up attracting nighttime offenders that are not found at other nearby stations. Thus, it is submitted here that the type of the physical and social environment cannot be taken for granted and isolated from the rest of the city; it does have a role to play in the *success*, the development and the safety of the station and its surrounding areas.

Finally, the idea of context and station area is not theoretically well-developed in the model. To some extent, the influence of the location of the station is regarded, but it is treated as unproblematic. Distance to the city center is bound to have an effect on the station capacity (and surrounding areas) to attract investments. The morphology of the city and the presence of physical barriers and amenities are also bound to have an effect on the station's success as a node. Equally important is the type of neighborhood they are emerged. In the next chapter a theoretical framework for crime and perceived safety is proposed using some of the basic ideas of the node-place model and adapting them by incorporating principles of urban criminology theories.

Chapter 4
The emergence in criminology of safety in transportation nodes

When a crime event occurs, it happens at a certain location. An offender who commits a crime comes from somewhere. As the event takes place, the target (or victim) and offender must be in exactly the same place at the same time. Thus, the intersection of these elements exemplifies what many criminologists have long suggested, that *place* plays a vital role in understanding crime and how crime occurs. Place, or the situational conditions in which crime occurs, can be a street, a park, a station, a house or a group of houses, or, on a larger scale, a border between countries or even the countries themselves. In this book, *place* is represented by Stockholm's subway or railway stations as transportation nodes. Each has an absolute, fixed location in space, but is still affected by its vicinity, neighborhood and city contexts.

The police have long recognized the inherent geographical component of crime by marking maps with pins, where each pin represents a crime event. However, it was not until the development of spatial analysis and event-mapping techniques that the importance of *place* in understanding crime distribution was further investigated by scholars and practitioners. Crime analysis has emerged because being able to identify high crime areas is an important step in crime prevention. Knowing the existence and locations of these crime concentrations (e.g. at a particular station) supports the actions of police officers and all other professionals and experts that deal with safety issues.

This chapter reviews relevant theories in environmental criminology that focus on the importance of *place* as a criminogenic element in the interplay between offenders and victims. This spatial emphasis means that to decrease crime, actions to make places safer require initiatives that focus on reducing opportunities for crime to happen at those particular places, in this case, at the subway stations. The literature provides a rich family of crime prevention theories that link environment to crime causation and fear. These theories will also be discussed in this chapter as support for the rationale behind the methodology adopted in this study.

4.1 Transportation nodes and environmental criminology

Criminologists have neglected the role of place in crime causation (Clarke and Felson 1993:4; Trasler 1993; Weisburd et al. 2011:11) as the focus has traditionally been on individuals' characteristics and contexts. Interestingly, however, even those who focus their research on why people become criminals recognize other elements in the crime equation. Already in 1947, Sutherland's seminal study suggested that the immediate situation influences the occurrence of crime in many

ways. How can theories that consider the situational conditions of crime help explain crime variation (and perhaps fear) at transportation nodes?

This one-sided focus on individual-centered explanations of crime in criminology has, according to Cohen and Felson (1979)[8], failed to recognize the importance of place as a structural backcloth for social interactions. They argue that for criminal events to occur, there is not only a need for a criminal, but also a suitable target and the absence of a capable guardian. They show that crime rates can be affected by the changing natures of targets or of guardianship, irrespective of the nature of criminal motivation. This *routine activity theory*, as it is called, also suggests that an individual's activities and daily habits in different parts of the urban environment are rhythmic and comprised of repetitive patterns, which in turn affect crime. This is certainly one of the most important features of the theory; in other words, it provides a more dynamic view of crime within the context of daily activity patterns.

When applied to transportation nodes, this theory helps explain why crime occurrence varies over time at subway stations (for instance, peak versus off-peak hours). The dynamic aspect of this theory has, however, been empirically limited by the lack of individual-level data on an individual's actions over space and time. So far, empirical studies have used land use indicators (e.g. location of city center and resident population density) as proxies for an individual's mobility or potential social interactions that may lead to crime (Roncek and Maier 1991; Osgood et al. 1996).

Crimes occur when and where the immediate environment makes the offender feel safe to act at the same time that victims are unfamiliar with the risks they face, for instance, when they are travelling. As suggested by Brantingham and Brantingham (1995:3):

> the urban settings that create crime and fear are human constructions...home, parks, factories, transport systems...the ways in which we assemble these large building blocks of routine activity into the urban cloth can have an enormous impact on our fear levels and on the quantities, types and timing of crimes we suffer.

In defining the concept of opportunity space, Brantingham and Brantingham (1984:362) suggest that potential crime victims/targets are not distributed uniformly in space. It is *the interaction of the location of potential targets and the criminal's awareness or activity space that culminate in particular patterns of crime occurrence*. They suggest that offenders learn through experience or social transmission clues that are associated with *good* victims or places where they can act. As transportation nodes concentrate large flows of people, it is easier for offenders to find potential targets. In criminology, stations are often regarded as crime generators and crime attractors, as these environments can potentially pull motivated offenders towards them and provide favorable conditions for crime to

[8] As Weisburd et al. (2011) suggest that, Cohen and Felson's ideas, that crime could be affected without reference to the motivations of individual offenders, was a truly radical idea in criminological circles in the late 1970s. They add nevertheless that place-based approach does not ignore offenders; it merely places them as one part of broader crime equation that is focused on the context of crime.

happen (Brantingham and Brantingham 1993;1995[9]). The impacts of these environments on safety vary over time as a result of their internal characteristics (physical and social) and as a function of the urban contexts in which they are imbedded.

Place, and the environmental features in it, can be assessed as a condition that facilitates or deters crime. Research has also been interested in looking at place at the very local level as a potential landscape for crime; for example, muggers need busy and semi-permeable areas, while burglars may prefer secluded access points. The scale is at the level of micro-environments, such as facades or street corners, but also the composition of these environments that make them more or less susceptible to crime (Jacobs 1961; Jeffery 1971; Newman 1972; Hillier 2004; Hillier and Sahbaz 2012). The idea behind these studies is that the potential offender can perceive different parts of an urban space – at the local level – as vulnerable to various types of crime. In a subway station, these features can be the types of exits a station has, the type of platform, or even whether or not the station has transparent walls facing the street.

Jacobs (1961) coined the phrase *eyes on the street*, stressing that the design of neighborhoods plays a role in defining opportunities for surveillance. Coming from the same line of thought, Newman (1972) suggests that the type of building influences what occurs on the streets around it – that the housing design can actually make individuals feel safe or make an offender feel motivated to commit an offence. Newman is particularly interested in identifying physical features in design that create what he calls *natural surveillance*, which is the *capacity of physical design to provide surveillance opportunities for residents and their agents* (Newman 1972:78). Environments that allow people to move around and interact with each other are bound to be safer than those that feel deserted or isolated. The role of surveillance (or social control) also applies to particular area of a subway station and/or the station itself in the neighborhood context.

According to Taylor and Harrell (1996), while Jacobs bases her arguments on the block and neighborhood as a unit, Newman focuses on the building and its immediate surroundings. However, both agree that neighborhoods with adequate surveillance, clear separation of public and private spaces, territorial control over personal spaces, and close proximity to well-used institutions lead to stronger resident-based, informal control of the areas; such informal control should lead to less delinquency, less fear, and less victimization.

Formal and informal social controls have important roles to play in determining crime levels at transportation nodes. Low social control may lead to disorder and physical deterioration. The mechanisms of social control are not well known for

[9] *Crime generators* are places to which large numbers of people are attracted for reasons unrelated to criminal motivation. Providing large numbers of opportunities for offenders and targets to come together in space and time produces crime or disorder. The mixed land use around a station may be a typical *crime attractor*, or a place affording many criminal opportunities that are well known to offenders. Criminally motivated people are drawn to such locales, thus increasing the number of crime and disorder events.

subway stations but, according to Wilson and Kelling's *broken window syndrome* (Wilson and Kelling 1982), unrepaired damage to property encourages further vandalism and other types of crimes.

The tradition of considering the demographic and socio-economic make-up of neighborhoods is not new; it started with the ideas propagated by the so-called Chicago School of Sociology in the beginning of twenty century. There has been a long tradition within criminology of approaching places as discrete units (such as neighborhoods) in the attempt to understand crime distribution. Shaw and McKay's (1942) work on Chicago argues that low economic status, ethnic heterogeneity, and residential instability lead to *community disorganization*, which in turn results in sub-cultures of violence and high rates of delinquency. Social disorganization theory suggests that structural disadvantage breeds crime. The main focus is placed on offenders and motivation (often indicated by an offender's place of residence). More recent approaches looking at the importance of neighborhoods in crime patterns have drawn on new concepts (such as social cohesion and collective efficacy) (Rosenfeld et al. 2001; Sampson et al. 1997). Although neighborhood-based studies continue to reveal strong associations between characteristics of urban areas and the locations of certain types of offences, there is little evidence to show how exposure to different urban environments (beyond place of residence or crime location) can influence an individual's decision to commit a crime.

Wikström (2005) argues in his *situational action theory* for the need for empirical studies that go beyond this perspective of crime location and offenders' residence. Wikström suggests that the urban environment does not affect individuals equally. Thus, the current incapacity for tracking individuals over space and time make researchers unable to suggest reasons why crime concentrates in certain places. For more details, see Wikströlm et al. (2010).

It is submitted here that if individual data over space and time are not available, then there are alternatives to the space-time dimensions of routine activity and their effects on safety. At transportation nodes, for instance, analyzing crime over specific time windows (e.g. peak and off-peak hours), as it is done in this book, can be useful in characterizing the situational causes of crime at particular stations. These time windows provide *snapshots* of the individual's routine activities over space and time, indicating how different features of the environment interact with individuals. Thus, having good artificial illumination at a station during a Swedish summer evening, with long hours of sunlight, has a weaker crime deterrence effect compared with the same conditions found at the same station in the winter (with a few hours of daylight).

Transportation nodes, as areas of convergence, concentrate people at certain times at particular places (stations). Thus, they can function as indicators of the city's rhythmic safety conditions. Wikström's and the previous theories discussed in this section play a key role in understanding the spatial and temporal variability of crime and fear in urban areas. Indirectly, they also provide theoretical frame-

works for defining society's response to these problems. Thus, the next section reviews some examples of place-based crime prevention.

4.2 Transportation nodes and crime prevention

Crime prevention entails any action designed to reduce the actual level of crime and/or the perceived fear of crime (Lab 2007:24). Actions that deal with reducing opportunities for criminal acts at a certain place (e.g. at a subway station) are the focus in this section.

One strategy for reducing the opportunity for crime is by increasing the risk of being caught and decreasing the rewards for committing crime for the offender. Increased visibility and natural surveillance are, therefore, considered key elements to succeed against crime (e.g. LaVigne 1997; Loukaitou-Sideris et al. 2002). These changes involve making crime more difficult, riskier, less rewarding, or less pardonable. This approach is known as *opportunity blocking* (Clarke 1995) and may have a greater direct effect on offenders than other crime prevention strategies. According to *rational choice theory*, the potential offender evaluates his or her own risk before making a decision to commit a crime – and the environment plays an important role in this decision. Although opportunity blocking is a different approach than individual-centered programs (e.g. change the life-course of potential and existing offenders), these two approaches are not exclusionary (Eck 1998). Thus, by not ignoring offenders, but focusing more on the role of context of crime, researchers led by Ronald Clarke in the 1980s began to explore the theoretical and practical possibilities of a place-based crime prevention approach, also called *situational crime prevention* (Clarke 1980; 1983; 1995; Cornish and Clarke 1986). Situational prevention comprises opportunity-reducing measures that are directed at highly specific forms of crime. This approach involves the management, design or manipulation of the immediate environment in as systematic and permanent way as possible, and make crime more difficult and less rewarding for the offenders (Clarke 1997:4).

Crime prevention practices centered on offenders are, as argued in the literature, only a way to neglect the proven effect the environment has on individuals. Since this effect is difficult to predict (and may vary), it seems reasonable (in terms of resources spent) to focus crime prevention on the place-based conditions where crime occurs, instead of only on people. Researchers who advocate such an approach argue that the context of crime provides a promising alternative to traditional offender-centered crime prevention actions (e.g. Weisburd et al. 2011). The question to be answered is why? Below, four arguments are put forward in favor of why place and its features should be considered in crime prevention.

1) As suggested by Eck (1998), most places have no crime and most crime is highly concentrated in and around a relatively small number of places. Some places are so crime-prone that they are labeled *hot spots* of crime

(Sherman et al. 1989). Examples from the literature show that 3 percent of addresses produce 50 percent of reported crimes in the USA. If one can prevent crime at these high-crime places, then one might be able to reduce total crime.

2) Situational crime prevention assumes that situations in which crime occurs are a more stable and predictable for crime prevention than are individuals (Weisburd et al. 2011). Sherman (1995) shows evidence that crime is approximately six times more concentrated among places than it is among individuals. Moreover, this pattern is stable over time. For instance, a criminal may leave a high crime area in a matter of days. However, transforming a neighborhood from a high-crime area into one with acceptable levels of safety may take decades.
3) Situational crime prevention shows that crime follows patterns of activities and land uses that are rhythmic (space-time). If these patterns are identified, crime can better be prevented over space and time. For instance, police patrols can be sent to places at certain times only, which may mean saving resources.
4) If crime is concentrated at a certain time and particular place, then there is no doubt that there is something about that place that leads to crime happening there and not elsewhere. As previously suggested, that particular place is criminogenic because the offender, the suitable target, and absence of a guardian combine to meet the necessary conditions for crime to occur.

Analyzing place-based crime

One of the most common ways of analyzing the spatial structure of crime is by identifying clusters or so-called *hot spots*. Harries (1999) defines a (crime) hot spot as a condition indicating some form of clustering in a spatial distribution. However, the author adds that not all clusters are hot spots because the environments that help generate crime—the places where people are—also tend to be clusters. Thus, a definition of hot spots has to be qualified, and in the case of crime, Sherman (1995) defines hot spots as small places in which the occurrence of crime is so frequent that it is highly predictable, at least over a one-year period. A subway station can be a hot spot if it has an unusually high number of crimes, taking into account the distribution of that same type of offence over the whole subway network and the passenger flow.

Hot spots can evolve or change over time (Ceccato 2005), be mobile or in transit (Tremblay and Tremblay 1998; Loukaitou-Sideris et al. 2002; Newton 2004), or even depend on human perception (Rengert 1995; Rattcliffe and McCullagh 2001). In this case, a number of techniques can be used to test concentrations of crime as clusters in space and time. Since crime clusters might expand or shrink in size over time (Ceccato 2005) police forces may use this information

to better tackle crime by making more informed decisions on where and, more importantly, when to dispatch police patrols. This book will provide evidence of these crime concentrations at subway stations but also over time (day, week, and season). It is also possible to use similar techniques to identify clusters of perceived unsafety at stations and in surrounding areas.

Situational crime prevention is more than detecting crime hotspots and police work. A development that is associated with actions towards blocking crime opportunities is the popularization of security objects; cameras and electronic devices that increase the potential of social control in a particular place. Firms offer a range of different types of hardware on the market: electronic security devices, fences, padlocks, alarms, security mirrors, and closed-circuit television (CCTV), most of them used on a daily basis for security in subway stations.

At the same time, security concerns have been taken seriously from the initial sketches to the final details of new housing development projects. Some of these new developments take the European standard for the reduction of crime and fear of crime through urban planning and building design into account. The European standard suggests key propositions based on European examples of good practice of Crime Prevention Through Environmental Design (CPTED) and situational crime prevention (CEN 2011).

In the mid-1990s, Sweden saw a parallel development is the reinstatement of community-based policing. Crucial to this decentralized structure was the 1996 national program for crime prevention, in which local police forces played a central role. Local cooperation through crime prevention councils was regarded as a key instrument in successful crime prevention. In Stockholm, municipalities and companies responsible for public transportation are often members of these local councils. At the same time, Stockholm has implemented of a range of initiatives making citizens more responsible for their own security. Security now incorporates volunteerism (people working without payment) through governance. Participatory frameworks have been popular in the last decade, particularly when the goals were to improve the safety of specific groups. Examples are the engagement of women in safety audits, some of which include subway stations and the immediate surroundings.

Crime prevention measures and participatory planning practices aiming at improving place-based safety are sometimes regarded with suspicion. Some suggest that any type of intervention must be done consciously. Listerborn (2007:74) suggests that *if the planners have poor knowledge about, or are prejudiced towards, the people they plan for, the result of the planning processes will illustrate just that*. Certainly this may apply to any type of crime intervention. Even in participatory frameworks, where the police's work is anchored with the representatives of the local community, initiatives that target places and their uses may look, at least to some, as intrusive and/or exclusionary. For instance, the installment of CCTV cameras in Stockholm's subway stations opened up discussions about who has the legal right to use and handle images from these devices and the risks these cameras may impose on personal integrity (see Koskela 2000; 2002). CCTV cameras

for surveillance purposes in stations may trigger different feelings based on the type of user, particularly those who might be more exposed to these devices than other types of users (e.g. disabled individuals, elderly, or mothers using the elevators). This fact calls for a critical perspective, perhaps more user-sensitive and gender-informed, on the use of situational crime prevention principles in routine police work and crime prevention practices in transportation nodes, such as subway stations.

A key requirement for the adoption of place-based actions is having evidence of where and when crime occurs. Relying on the theories of this chapter, a theoretical framework for analyzing crime and perceived safety is proposed in chapter 5.

Chapter 5
A conceptual framework for safety in subway stations

Mobility is a basic requirement for modern societies. Moving safely is a right that should be attained by all, regardless of an individual's abilities, resources, or chosen means of transportation. One in five Europeans spends more than two hours commuting daily (StepStone 2012), which, in many large European cities, means spending hours in trains, buses, or public transportation environments (Greenberg et al. 2005). Are public transportation systems safe environments? The simple decision one takes to go from home to work implies a change in one's safety status (increase or decrease), depending on how, when, and where one moves. In the next sections, a conceptual framework for the analysis of safety in transportation nodes, more specifically, in subway stations, is suggested.

5.1 Crime and disorder at transportation nodes

Subway and bus stations, as other transportation nodes, concentrate large flows of people. They are part of transportation systems that help reduce the time required for human activities by making places accessible. They compress *lives into relatively small spaces* (Miller 2005:381), disperse passengers throughout the network, and reunite them at transportation nodes. Public transportation is an essential part of the city structure; it constitutes a fundamental piece of the economic vitality of an area and a key element of the citizens' welfare. According to Newton (2004), transportation systems are a multifaceted arena, with a complex interaction of settings (buses, trains, and trams), facilities (stops, stations and interchanges), and users (staff and passengers).

Transportation nodes are particularly criminogenic settings. Research has long suggested that physical and social features found in the environment of transportation nodes may draw the attention of those people with high levels of criminal motivation. The design of these facilities and the internal and external environments may all influence the levels of crime experienced at the stations. Smith and Cornish (2006) point out overcrowding and lack of supervision as important environmental features that contribute to the increased risk of crime. Overcrowding, especially during peak hours, facilitates thefts and other property crimes. During off-peak hours, poor social control (lack of supervision by staff and/or lack of potential guardianship by passengers and transients) contributes to vandalism and graffiti, robbery of staff and passengers, assaults on staff and passengers, or fare evasion.

However, a journey does not start at the stations or bus stops. Daily individual trips that involve the use of public transportation start somewhere else in the city,

often not very far from a transportation node. According to Smith and Clarke (2000), crime can occur in at least three different types of environments. First, when the individual is walking to, from or between transportation nodes, he or she is exposed to urban environments with different criminogenic levels where victimization may occur. Second, when the individual is waiting for transportation or is on the move between different sections of the stations (e.g. on the subway station platform or walking from the ticket area to the platform), there is always the risk of mugging or violence. Third, when the passenger is travelling on board a mode of transport. Pickpocketing is a common offence in crowded environments, such as in a bus or in the cars of a subway or train. Moreover, crime targets vary and can include the system itself (e.g. vandalism and fare evasion), employees (e.g. assaults on ticket collectors or guards), and passengers (e.g. pickpocketing or assault).

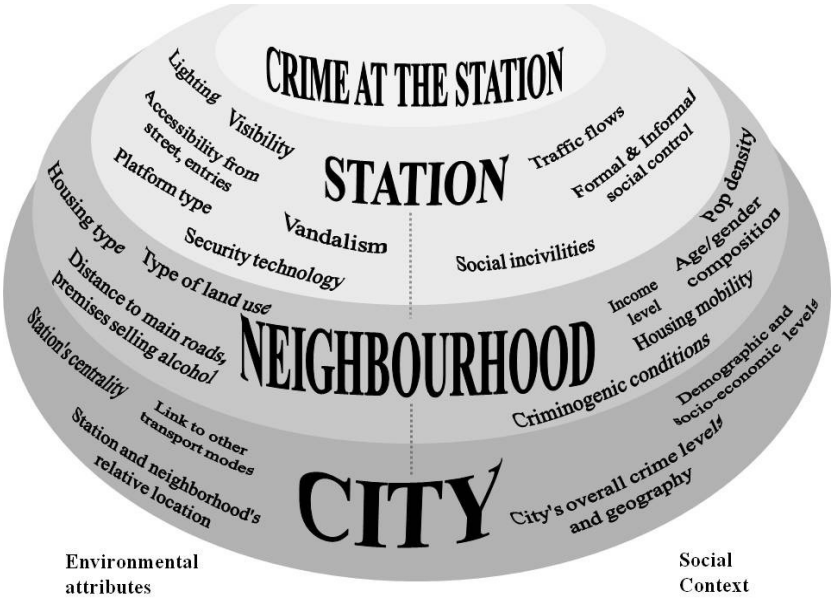


Figure 5.1 - Safety in underground stations: the conceptual framework.
Source: Based on Ceccato (2010; 2011).

As far as the subway system is concerned, crime does not occur equally across stations. It may vary even between the sections of the stations and over time. For instance, stations' platforms may be safer than their exits; or it is possible that poor guardianship during the slow afternoon hours makes them susceptible to robberies than they are during rush hours. The stations' surroundings are also an important criminogenic factor. High crime areas tend to affect victimization at the stations, and inner city stations may be extra vulnerable to crime spill-over from mixed land use, with bars and restaurants, that is typical in city centers. In this sec-

tion, a conceptual model is suggested to help organize the empirical analysis that is put forward in the next chapters of this book. The model relies on principles of urban criminology theory and situational crime prevention. These theories, combined, lie behind the empirical work on crime and victimization at subway stations presented in this book. They may also fortuitously support some of the fundamental principles used to interpret the relationship between perceived safety and physical and social environment of the stations.

Crime (and disorder) at subway stations is determined by (Figure 5.1):

(1) the physical and social environmental attributes at the station;
(2) the characteristics of the immediate environment and neighborhood;
(3) the relative position of both the station and neighborhood in the city.

The physical and social attributes of the station's environment

The station's vulnerability to crime depends on *its physical environment* and the type of *social interactions* that take place at this transportation node. The physical environment refers to the *hardware* of the station; it is composed of everything that is there and is visible to the human eye. Stations may vary by size (e.g. stations belonging to transportation hubs tend to be large), type (e.g. central stations are often underground, while outlying stations tend to be above ground) or style (e.g. modern, see-through walls), but still they follow some basic standards. They have entrances/exits (e.g. tunnels, stairs, elevators, shops, and restaurants), lobbies (e.g. ticket booths, automatic controls, and commercial shops), transition areas (e.g. stairs and elevators), platforms (e.g. single and multiple), and they are connected to the city through the immediate surroundings (e.g. streets and parking lots). Regardless their layout, subway stations are often composed of five settings (Figure 5.2):

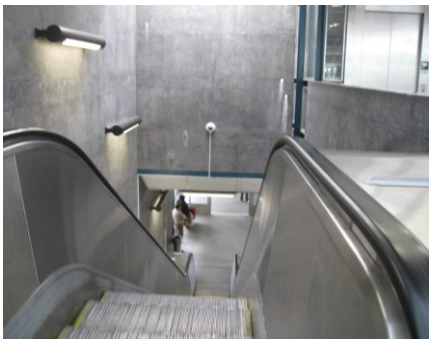
(1) Platform,
(2) Transition,
(3) Lobby,
(4) Entrance/Exit,
(5) Immediate surroundings.

The station is constituted of the platform where the trains arrive and passengers exit or wait for the train. The transition area commonly includes stairs and elevators from the platform up to the lobby, where control gates/ticket booths are located. The lobby may be an open area that ends at the entrances/exits. Commercial shops may be found in lobbies and entrance/exit areas. The entrances/exits are areas limited to entering the lobby area directly from the street or via doorways, stairs, elevators, or tunnels. The immediate surroundings are what individuals see from the station entrances/exits, comprised of a couple meters' distance from the entrances/exits.

The literature shows that physical characteristics of stations, such as lighting, fencing, open design, and security hardware, reduce crime opportunities. It also indicates that escalators located at the ends of the platforms, clearly visible ticket booths in the lobbies, and overpass walkways for the overview and separation of passenger flows are all factors positively affecting safety at stations (Gaylord and Galliher 1991; Myhre and Rosso 1996; LaVigne 1997).

Platform

Lobby



Transition

Entrance/exit

Immediate surroundings

Figure 5.2 – The five sections of subway stations.
Source: Photographs by Adriaan Uittenbogaard and Roya Bamzar 2011.

Piza and Kennedy (2003) describe that the easy entrance and exit of subway stations, on one hand, and the passengers' lack of familiarity with the subway stations, on the other hand, lead to increasing the opportunity for offenders to commit crimes. The truth is that a very limited number of studies focus on the relationship between station entrances (number and design) and rates of crime and disorder. The environmental design of a place and its auxiliary sections, such as entrances and exits, influences surveillance and may affect opportunities for crime (Newman 1972). This means that what happens at the stations depends not only on their physical environments, but also on the human activities that takes place at these transportation nodes when individuals are on the move.

Researchers argue that safety directly or indirectly relates to the visibility of passengers; the possibilities to be seen and to see others. In Los Angeles, a study of Green Line light-rail stations (Loukaitou-Sideris et al. 2002) shows strong links between crime rates and stations with dark hiding places or with poor visibility from the surroundings (and the opposite for stations with good visibility). Cozens et al. (2003) suggest that physical environments allowing for good visibility at railway stations are the most crucial contributor to station safety.

Visibility can also be translated into one's capacity to exercise social control, which is a crime deterrent. Social control can be formally and directly practiced by guards and police officers. It can also be indirectly performed by experts at safety management centers with the help of images from CCTV cameras[10]. Social control can also be informally exercised informally by passers-by. As far as formal control is concerned, Chaiken et al. (1974) show, for instance, that crime rates in New York's subway were reduced when the number of police officers increased during a certain time of day, and with no signs of crime displacement during other hours. Policing operations along transportation routes in London and Liverpool, U.K., show that increased patrolling on and along the routes decreased crime levels up to 400 meters from the route (Newton et al. 2004). However, Kenney (1986) do not corroborate these findings as patrols did not reduce crime at railway stations in the USA. In Australia, a set of security devices (screens, guards, and cameras) reduced (bank) robberies (Clarke et al. 1991).

The literature shows evidence supporting a positive effect of CCTV on crime reduction, but its effectiveness may differ by type of offence and the evidence is not always conclusive (Brown 1995; Welsh and Farrington 2002; Tilley 1993; Squires 1998; Short and Ditton 1996; Armitage 2002; Priks 2009). Installation of CCTV in London underground stations led to a reduction in robberies compared to a control group of stations (Webb and Laycock 1992). LaVigne (1997) shows that staffing entrance kiosks during Washington D.C. subway opening hours was important for maintaining social control at the stations. Station attendants were aided by CCTV at all unmanned entrances, tunnels, and platforms, and they carried two-way radios to report crimes and maintenance problems. In Stockholm, CCTV

[10] Closed Circuit Television Surveillance - CCTV – is cameras used for monitoring and crime prevention. This type of intervention is often used in public and private settings to prevent personal and property crime and disorder (Welsh and Farrington, 2002).

cameras have been installed in 84 subway stations. The results (Priks 2009) show an almost 20 percent reduction in the overall crime rate at subway stations in the city (high-crime stations), while there was no effect on crime at the stations outside the city. Pickpocketing, drug-related crime, and robbery each had a 20-40 percent reduction, while crime committed in the heat of the moment, such as sexual assault, did not change. Priks (2009) suggests that, since police and security guards can reach the subway stations inside the city much faster compared to those outside the city, criminals are more wary of committing crime in front of CCTV cameras installed in the inner city stations. Also, most of the large stations are typically indoors with good illumination, so CCTV might be more effective under such conditions, while suburb stations are typically smaller and do not have a good lighting system, and CCTV cannot cover the whole surrounding area.

Social control can be also informal. Transportation sites are often crowded, but lack capable guardians—persons who, sometimes just by their presence, discourage crime from taking place (Cohen and Felson 1979). Felson (2006) suggests that multiple actors exercise social control: *handlers* who control potential offenders, *managers* who control places, and *guardians* who control targets. A thief may give up stealing a purse if he notices that he is being watched by other passengers or by the restaurant owner. In the case of juveniles at a station, handlers could be parents, teachers, siblings, etc. Place managers can be subway personnel, guards, or parking lot attendants. Considering targets, there are two types of guardians: formal guardians whose responsibility is to protect people and property from crime, such as police officers and security guards, and informal guardians, including friends and others who are at the same place as the target.

The capacity of individuals' intervention cannot be overestimated. However, the existence of nearby potential controllers or guardians does not necessarily guarantee surveillance (Ceccato and Haining 2004). Travelers, who might be considered informal guardians, often have no sense of ownership while in transit. They might be unwilling to get involved in places like a station since it is not a place that they feel attached to or that belongs to their home environment. A number of studies support the role of guardianship in crime reduction, but others are inconclusive. The results of four studies show that increased guardianship at parking lots led to a decline in car-related crime (Poyner 1991; Laycock and Austin 1992; Poyner 1994; Barclay et al. 1996), while Hesseling (1995) did not find any reduction.

Public disorder associated with property damage and littering tends to attract other crimes. LaVigne (1997) finds that being tough on quality of life violations (such as smoking or eating on trains, and promptly reporting all vandalism and graffiti to maintenance personnel to ensure a safe and clean environment) helped to keep crime rates low in the Washington D.C. subway system. Visible, sometimes noisy events may promote the notion that *no one is in control* or *no one cares* about what happens in the area. Referring to neighborhoods, Wilson and Kelling (1982) suggest that unrepaired damage to property encourages further vandalism and other types of crime; the so-called *Broken Window Syndrome*. The

mechanisms are not well known for subway stations; however, littering and illegal advertisements at entrances/exits seem to be indicators of the local criminogenic conditions. Whether crime at subway stations can be seen as a barometer of the neighborhood context (or vice-versa) is an issue discussed in detail in the next section.

The station in the neighborhood

Safety conditions at a subway station are influenced by its neighborhood environment in two ways: (1) the type of land use in the immediate surrounding area as well as the social activities it may attract, and, (2) the demographic and socioeconomic characteristics of the population residing or working in the neighborhood.

The relationship between neighborhood conditions and crime was first assessed in the seminal work by Shaw and McKay (1942) in Chicago, and later coined as the main reference to the *social disorganization theory*, one of the most important theoretical pillars in urban criminology. In this study, the authors argued that low economic status, ethnic heterogeneity, and residential instability leads to community disorganization. Social disorganization theory links many forms of crime with weak informal social control, often present in high-crime areas, regardless the location in the city. The lack of social organization results in a culture of violence and high rates of delinquency. Thus, deprived areas with low social control run higher risks of crime, as do transportation nodes located in those areas (Pearlstein and Wachs 1982; Hirschfield et al. 1995; Loukaitou-Sideris 1999; Loukaitou-Sideris et al. 2002; Ihlanfeldt 2003; Newton et al. 2004, the only exception was LaVigne 1997).

A subway station is often planned to move as many as much passengers as possible. It tends to be within walking distance of a residential area, working place, industrial area, or commercial center. This centrality feature of transportation nodes has criminogenic implications. Different types of land use affect the social interactions at those places and, consequently, their geographies of crime. For instance, inner city areas with mixed land use tend to be more exposed to crime than residential areas (Sherman et al. 1989; Loukaitou-Sideris et al. 2002; Ceccato 2009). Clarke and Eck (2007) suggest that certain facilities can be called *risky* and affect crime occurrence at their locations as well as within their vicinities. Examples are bars, restaurants, stores, shopping malls, ATMs, bus stops, railway stations, parking lots, apartment buildings, mobile home parks, libraries, hospitals, schools, public swimming pools, and marinas. This is not a surprise since it is partially the overall structure of the urban environment that shapes people's movements and allows the convergence of offenders and potential targets/victims (Newman 1972; Cohen and Felson 1979).

Kinney et al. (2008) suggest that commercial areas, shopping centers, entertainment locations, and multi-functional areas correlate with high concentrations of crime events (for instance, assault rates in such areas are six times higher than in residential areas). Pearlstein and Wachs (1982) examine crime on buses in California. They find that only 88 out of 233 routes encounter any serious crime incidents and that these criminal routes are mostly located in high crime-rate areas. In Merseyside, U.K., the damage of bus shelters was related to the presence of youth, playgrounds, open spaces, and schools with high truancy levels rather than with pubs or other alcohol-related premises (Newton and Bowers 2007).

The relationship between surrounding land uses and crime incidents at stations tends to be statistically significant as certain environmental features either attract offenders (i.e. offer good opportunities) or influence criminal activities (by concentrating potential offenders and encouraging anti-social behavior) (Loukaitou-Sideris 1999).

In the USA, LaVigne (1997) finds that factors that contribute to Washington D.C's low crime rates in the subway included: a system architecture that avoids hiding places and reduces passengers' fears, the possibility to buy tickets in advance, and the opportunity to control certain behavior violations and land use, both at the station and in the station area (no public restrooms, lockers, or excess seats on which potential offenders can loiter, no fast food establishments, and continuous surveillance either by personal or by CCTV). Also in the USA, Loukaitou-Sideris (1999) and Loukaitou-Sideris et al. (2001) confirm that the characteristics of the surrounding environment in which a transportation node is located are of high importance in determining the safety experienced by travelers. Thus, a station may be more vulnerable to crime if it is located in a high-crime area that combines risky socio-economic factors with risky facilities (e.g. mixed land use, high-rise buildings, close to premises selling alcohol, and high concentrations of young males).

Subway stations, themselves, may be criminogenic, either because they constitute a crime attractor or because they contribute to other types of crime happening in their surrounding areas, such as offering an easy escape for offenders. Block and Davis (1996) reveal that street robberies are concentrated within one and a half blocks of train stations in Chicago. Block and Block (2000) present similar results around subway stations in the Bronx. Wright and Decker (1997) argue that these transit stations function as crime generators; passengers who are drunk or unfamiliar with the area are attracted to these stations. Piza and Kennedy (2003) assess a possible relationship between street robbery and subway stations in Newark. The results show that 25 percent of total street robberies happen within 792 meters of a subway station. A study on crime and bus stops in Newark (USA) suggest that both the presence of bus stops and commercial centers are related to higher levels of crime (Yu 2009) and this author points out that the presence of bus stops results in higher numbers of crime for all types of offences. Although much is explained by the geographic locations of the bus stops in high-crime are-

as, the bus stops were found to function as high-crime attractors towards their surroundings, creating even more criminogenic places.

The station in the city context

The risk of being a crime victim is not equally or randomly distributed over space; some parts of a city are more criminogenic than others. The relative position of both the station and the neighborhood in the city should also affect their crime levels and geography. Thus, the decisions that an individual takes when making a journey may imply in a reduction of his or her own safety, depending on where and how he or she moves.

Urban criminology has shown plenty of evidence of how city centers are more criminogenic than other parts of the city (Sherman et al. 1989; Wikström 1991; Ceccato et al. 2002; Loukaitou-Sideris et al. 2002; Smith 2003; Ceccato 2009). Thus, it could be expected that stations located in inner-city areas would tend to be more targeted by crime and acts of disorder than those in the outskirts. Alternatively, end stations, those at the ends of subway lines, can be more criminogenic than those found along the lines. These end stations are often linked to other transport modes, with large flows of passengers, and may adjoin parking lots and commercial areas.

The city's geography and the presence of different geographical barriers, such as a lakes, mountains, rivers, or parks, are also influential in defining regional patterns of offences, which may indirectly affect the safety conditions at a subway station. These physical features might provide hidden places as well as escape opportunities for motivated offenders at the stations. The city's geographical relief and terrain may also influence offenders' spatial decision making, e.g. when and where to target victims. Breetzke (2012) shows, for example, that residing at a higher altitude reduces the risk of burglary, although residing on steeper slopes has no effect.

Of course, subway stations exist only in cities at the top of the urban hierarchy (in well-developed with dense populations), which means they often tend to have higher crime rates and levels of victimization than smaller cities, for instance, because of the concentrated crime opportunities per unit area. Large cities tend to have a richer variety of crime types and higher crime rates than smaller or rural municipalities. Urban areas with high crime rates tend to have locations where crime is concentrated, and transportation nodes might be particularly places of crime under these circumstances.

The link between crime and size of an urban area is not a new fact (for a review, see Glaeser and Sacerdote 1996). A good transportation system intensifies social interactions and knowledge of possible targets in large cities. Urban density plays a particular role in the accumulation of this knowledge through social con-

tact. Glaeser and Sacerdote (1996) suggest that urban density creates proximity between wealthy potential victims and motivated offenders.

Large cities normally offer a number of activities and services that are rarely found elsewhere: sport arenas, conference centers, commercial outlets, airports, and university campuses, just to name a few. They bring together large flows of people at all and/or at particular times, which affect crime levels. Recent studies show evidence of the effect of sporting events on crime: sharp increases in assaults, vandalism, arrests for disorderly conduct, and arrests for alcohol-related offenses (Rees and Schnepel 2008). Transportation links between these premises and the rest of the city are offered by public transportation. In fact, the transportation system, such as the subway, becomes both a mean and a target for criminal acts at these events.

5.2 Perceived safety at transportation nodes

Regardless where individuals are, in the public transportation system or in their neighborhood, there seems to be a collective level of tolerated (un)safety that individuals use as a reference to define when and where they feel (un)safe. When this level is not met, more people start expressing a sense of insecurity. The media plays a significant role in creating a darker picture of crime risk than is always reflected by reality. For instance, UNHSP (2007) shows that readers of national tabloids in the U.K. are twice as likely to be worried about violent crime, burglary, and car crime as people who read other newspapers.

Ferraro (1995:8) defines fear of crime as *an emotional reaction of dread or anxiety to crime or symbols that a person associates with crime*. Fear of crime does not happen in a vacuum. An increase in crime should affect perceived safety. However, this simplistic causal relationship is not at all easily confirmed in reality. Previous studies have shown ambiguous links between victimization and fear of crime (Garofalo and Laub 1979). Economic insecurity, such as being unemployed, can also affect the overall feeling of safety, but there are other factors as well. Therefore, how a person fears is dependent on his or her individual characteristics, such as physical abilities, age, gender, socio-economic status, ethnic background, and previous personal experience. The individual dimension of fear is related to the vulnerability hypothesis, where those perceiving themselves as vulnerable are likely to be more fearful. Valentine (1990) also suggests that, in the absence of prior experience or familiarity with a particular place, judgment is likely to be based on preconceived ideas about similar settings and their occupants. As defined by Wyant (2008:40), fear is a *product of individual-level processes, many related to perceptions of personal vulnerability to crime, and of ecological (e.g. neighborhood) setting conditions and dynamics* (for a complete review of the causes of fear, see Gerber et al. 2010), and, above all, it is an ongoing process. As Fyhri and Backer-Grøndahl (2012:475) well suggest: *people's fears and risk perceptions are*

determinants for what kinds of risks they can accept to be exposed to, but these same feelings and thoughts are also shaped by the extent to which one is exposed to different risks. If a person avoids taking risks, fear may be fed by other sources than reality itself.

In practice, low perceived safety affects behavior, becoming a barrier to individuals' physical activity and good health (Miles and Panton 2006; Eyler et al. 1998). Individuals start expressing evidence of functional fear (Atkins 1990; Jackson and Gray 2010) by trying to prevent something bad from happening. Foster and Giles-Corti (2008) suggest that constraining behavior might be adopted, so that exposure to potentially dangerous situations is minimized by staying away from certain places or avoiding long walks (Ross 1993). Some individuals take security precautions (Skogan and Maxfield 1981), for example by buying a car or, at least, avoiding public transportation at certain times in order to stay away from the problem. The comprehensive review by Atkins (1990) indicates that the level of fear was high across a wide range of urban locations in the U.K. in the 1980s. A recent survey shows that 18 percent of respondents in London (10 percent in the U.K. overall) are dissuaded from using buses as much as they would have liked due to fear of crime.

At the collective level, fear creates borders between social groups and neighborhoods (Caldeira 2000; Landman 2005), although some argue that the opposite is true; that isolation also creates fear and suspicion (e.g. Pain 2010). Decreased mobility harms social interactions, which makes people even further isolated. Fear, therefore, affects the health of the community: people's mutual trust and social cohesion (Riger et al. 1981; Garcia et al. 2007).

Table 5.1 - Modifiers of fear and perceptions of risk.

Socio-psychological	Socio-demographic	Environmental
Experiences and Memories	Gender	Geographic Setting
Prior Victimization	Race/Ethnicity	Physical Incivilities
Familiarity with Setting	Age	Social Incivilities
Media Stories	Poverty	Boundedness
Admonitions	Disability	Natural Surveillance Opportunities
	Sexual Orientation	Lighting Level

Source: Loukaitou-Sideris and Eck (2007).

In summary, there is interplay of a number of factors affecting fear. Loukaitou-Sideris and Eck (2007) suggest three types of modifiers of fear and perceptions of risk (see Table 5.1): socio-psychological, socio-demographic and environmental. In this section, some of these modifiers of fear are discussed in relation to transportation nodes, their environment and surrounding areas.

Factors contributing to fear at the station

The micro-spaces of transportation nodes influence the levels of crime and perceived safety in the system (Atkins 1990; LaVigne 1997; Loukaitou-Sideris 2006). Micro-spaces refer to, for example, the type of facade, the height and density of buildings, the numbers and types of streets and entrances but also to modern features of the physical environment that directly affect surveillance opportunities. This influence of micro-spaces is also confirmed by evidence from the USA, which links fear to the presence of certain environmental features in a public setting, including darkness, desolation, and lack of opportunities for natural surveillance by the general public or the occupants of surrounding establishments (Atkins 1989; Loukaitou-Sideris 2006). Loukaitou-Sideris (2012) suggests that desolation and lack of people and activity at a station platform or bus stop bring anxiety and fear that no one will be there to help if a crime occurs. The absence of visible staff and other passengers contribute to concerns about possible victimization.

Architects have long suggested that the type of building and architectural design influence what occurs on the surrounding streets. Paths that have many bushes might give offenders places to hide (Newman 1972). It is argued that cutting back on the distances to be walked and removing hiding places not only affects the opportunity for crime, but also the fear of crime. The types of social interaction that these spaces attract are fundamental in turning them from *unsafe* to *safe*, as recently confirmed by the findings of Hillier and Sahbaz (2012). These authors suggest that the space's vulnerability depends not only on particular types of streets, buildings, or facades, but also on (or in combination with) individuals' interactions and the socio-economic contexts of their daily activities. Various kinds of harassment at the station, such as being shouted at or pestered, can be frightening. Drunkenness, rowdy behavior, loutishness and hooliganism may not even be directed at particular individuals, but they increase unease among passengers. Atkins (1990) suggests that these events are serious, not because of the risk of being victimized by crime, but rather because of the risk of encountering a variety of unpleasant, anti-social acts, some of which can lead to serious consequences. Some of these principles have guided what is often called by urban planners as crime prevention through environmental design (CPTED). The general idea is that environments can be planned in a way that reduces the possibility of crime occurring, by stimulating surveillance, fostering territoriality and reducing areas of conflict by controlling access from outsiders (Jeffery 1971; Newman 1972). Although some of these theories developed between the 1960s and 1980s highlight the influence of design and micro-spaces on safety (Jacobs 1961; Barker 1968; Thomlinson 1969; Sommer 1972; Newman 1972; Coleman 1985), they have been controversial and attracted a great deal of criticism (e.g. Pain 2001; Sweet and Escalante 2010). CPTED principles were criticized for portraying individuals as passive agents, and neglecting the social construction of physical space altogether (Smith 1987; Pain 2000). Attempts to develop CPTED strategies have included

anti-segregation measures and active community participation (Cozens et al. 2005), and the gender perspective was put into practice in Canada with the development of safety audits with women's groups, police, and transit officials as participants (Wekerle and Whitzman 1995). It is submitted here that the value of these theories resides in the attempt to gain a better understanding of the effect of micro-spaces on individuals' behavior, including the expression of fear that can be broken down by groups.

In a subway station, these micro-spaces can be translated as hiding places, dark corners, and places with insufficient illumination that may contribute to an offender's decision to commit an offence. If this is correct, passengers react to these micro-spaces as soon they see them, by expressing fear and avoiding certain places in the station. It is not an easy task to identify factors that make passengers feel unsafe. Findings from two U.K. surveys[11] are summarized by Smith and Cornich (2006:8). Despite the fact these surveys reflect British conditions and may not be representative of other countries, they are useful to exemplify what passengers value the most as far as the environment at the station is concerned. Factors that affect negatively individual personal safety are of the following types:

(1) *Lack of visibility* – This relates both the individual's capacity to see others as well as to be seen by others. This capacity is limited by inadequate or inappropriate lighting at the station and surrounding areas as well as by the lack of clear sightlines, such as lack of visibility between train cars. The presence of nooks or recesses available as hiding places for potential offenders can also affect passengers' feeling of insecurity. The presence of overgrown vegetation at the station or in the immediate vicinity of the station may also affect passengers' perceived safety to and from to the transportation node.

(2) *Perceived lack of potential assistance or protection* – Perceived safety relates to the social environment at the station. Thus, if the station is often empty of other passengers or visible or available personnel, passengers may find the station unsafe. Research has shown that passengers feel that public transportation staff plays a central role in providing reassurance. The low capacity for guardianship also includes lack of CCTV surveillance, lack of mirrors, radios, or other physical features of the station's environment (e.g. long corridors or long flights of stairs).

(3) *Passenger uncertainty* – Passengers may feel unsafe when they are unfamiliar with the environments, to which they are exposed, for instance, a subway station at certain times of the day. There are transportation nodes that are better equipped than others in providing accurate information. Lack of or inaccurate information may also contribute to low perceived safety if passengers have to wait a long

[11] U.K. Department of the Environment, Transport and the Regions 1996; Crime and Concern and Transport and Travel Research 1997; Crime Concern, 2004.

time for the train. Inadequate internal signage at the station (e.g. when the station is under refurbishment) also affects passengers' perceived safety.

(4) *Perceived lack of care or control* – Signs of physical deterioration are thought to be more important determinants of fear of crime than the actual crime itself. This is true anywhere. Poorly maintained stations, with litter and smelly corners, show signs that nobody is in control. Lack of boundaries between the station and the surrounding area may also make passengers confused about what directions to take. Lack of clearly defined personal space at the station may also affect perceived safety of passengers, for instance, when they have to squeeze together on benches or while standing in subway cars. The social interactions that take place at the station may also lead to lack of perceived safety, for example, the presence of rowdy young people, overcrowded sections of the platform or waiting area, or the presence of people who are drunk or asking for money.

(5) *Prior victimization or awareness of others' victimization* – Having been a victim of a crime or incivility; for example, having been pushed, subjected to intimidation, or assaulted may affect current perceived safety at the transportation node. Experiencing or observing other people's victimization at the station or elsewhere may also affect an individual's level of personal safety at the station.

(6) *The station's context* – Passengers may avoid using stations that are surrounded by criminogenic land uses (e.g. a station close to bars, restaurants, stores selling alcohol, or sport arenas) and trigger activities that are perceived as unsafe. Parking lots and other desolated areas may also generate fear among passengers. City center areas, where large transportation nodes are located, also tend to be perceived as less safe, particularly after dark (e.g. Bromley and Stacey 2012).

Neighborhood effects of fear at the station

Passenger safety surveys often reveal a puzzling picture. In the U.K., passengers report high levels of fear when waiting for and travelling on public transport, even when levels of recorded crime on the system are relatively low (Smith and Cornish 2006). Also in the U.K., the part of the journey spent on board a vehicle is often perceived to be safer than the part spent walking to/from the stop or station (U.K. Department of the Environment, Transport and the Regions 1996). In Stockholm, the perceived safety pattern is similar. In this Scandinavian capital, the problem with perceived safety seems to be with the environment around transportation nodes. Most travelers declare feeling safe on their trip and in the stations but

more than half of the respondents feel unsafe in areas nearby the stations, on their way to/from these transportation nodes (SL 2007). These findings indicate the influence of neighborhood on perceived safety. In New York, Toronto, and London, Wekerle and Whitzman (1995) find that the safety perceptions of riders influence their decisions on whether or not to use public transportation.

Loukaitou-Sideris and Eck (2007) indicate that walking and cycling are greatly influenced by the neighborhood context since significant portions of these activities take place in the local environment of neighborhood streets. Safe neighborhoods invite outdoor activities, including daily walks to train stations. However, if the neighborhood is perceived as dangerous, those who have the chance to choose an alternative walking path will certainly avoid these areas.

According to Loukaitou-Sideris (2012), researchers have found that perceptions of risk and fear are generated by neighborhood incivilities, distinguishing between physical incivilities (e.g. deteriorated or abandoned buildings, litter, graffiti) and social (public drunks, beggars, panhandlers, or homeless persons). Wilson and Kelling (1982) suggest that acts of vandalism and public disorder function as symbols of the extent to which a neighborhood is in decline. This decline may translate into declared levels of fear of crime. As Skogan (1996) suggests, this is not only because signs of physical deterioration are often visible, but also because they are able to capture a much broader range of problems, and are therefore more informative for residents than official crime statistics.

Reviewing findings from transportation nodes in Los Angeles, Loukaitou-Sideris (2012) suggests that unkempt and littered settings make transportation users feel more fearful – for a good reason: a relationship was found between physical incivilities and crime. Station neighborhoods with littered sidewalks, an abundance of graffiti, and deteriorating buildings have higher numbers of less serious crimes than well-kept neighborhoods. In the U.K., the rowdy behavior of young people is often felt to be intimidating or threatening by other passengers (U.K. Department of the Environment, Transport and the Regions 1996).

Individual factors affecting perceived safety

Individual factors play an important role in defining perceptions of risk and safety in transportation (Fyhri and Backer-Grøndahl 2012). Gender and age are perhaps the strongest ones. A number of studies have confirmed that women are more concerned than men about their personal safety in public transportation (Brown 1998; Crime Concern 2004; Loukaitou-Sideris and Fink 2009), but also in other urban environments (Box and Hale 1988; Koskela 1999; Loukaitou-Sideris and Fink 2009). Figure 5.3 shows findings from a U.K. survey where women more often declare feeling unsafe or very unsafe walking to facilities, waiting on platforms, or travelling on the subway. Other research in the U.K. has shown that women consider buses the safest way to get around compared with other modes of

public transportation, especially after dark. Women state that they feel less safe on rail modes, even during the day (Wekerle and Whitzman 1994).

Researchers have suggested that fear of stranger-danger encountered in public spaces has been much more engrained from childhood in women than in men. It has also been suggested that women are more fearful because of their social and physical vulnerabilities (Skogan and Maxfied 1981). One of the reasons for these unbalanced levels of fear is that women and men are victimized by crime in different places. Regardless of which part of the city women live in, the home tends to be more dangerous than any outdoor environment. The international literature on sexual violence indicates that rape in outdoor places committed by a stranger, for instance, tends to occur in areas characterized by construction sites, parks, urban renewal, and temporary lodgings (e.g. Pyle 1974; Canter and Larkin 1993), which also feeds the idea of public places as dangerous places. According to Smith and Cornish (2006) women are more fearful of sexual crime and harassment in public transportation, whereas men tend to be more fearful of personal violence committed by other groups of men.

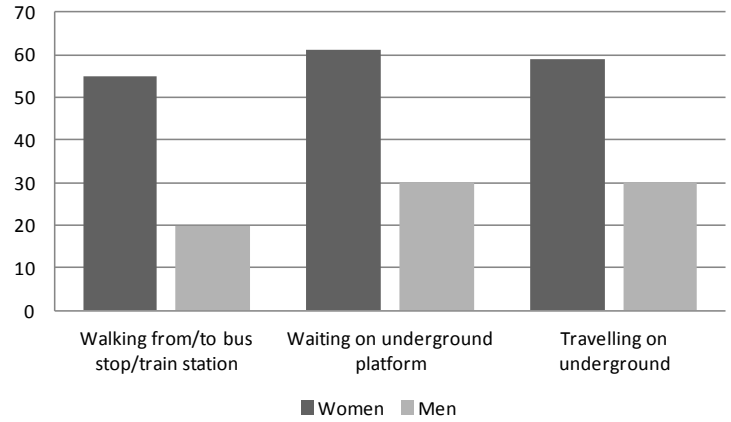


Figure 5.3 – Percentage of women and men reporting feeling unsafe or very unsafe after dark at different transportation locations.
Source: Adapted from Crime Concern (2004).

In one of the seminal studies in this area, Valentine (1990) finds that women anticipate being at risk in several specific settings. Her evidence is based on a medium-sized town in the U.K. and includes places such as multi-story parking structures, public transportation stations and bus stops, open spaces, alleys, and underground passages.

Researchers suggest that general measures addressing low perceived safety fail to address crime in public spaces by strangers only (Sweet and Escalante 2010) and ignore the wider social causation of women's fear (Pain 2001). This is certainly true, but does not help urban planners and transportation experts in defining ac-

tions for safety improvements at, e.g. transportation nodes. Perhaps the way to go forward is to look at how gender, age, and fear interact in different places and times. For instance, Bromley and Stacey (2012) have recently found significant gender differences in perceived safety of boys and girls in the city center environment (e.g. where many transportation nodes are located), but no difference in perceived safety in their home areas.

One of the difficulties in planning safety with a gender perspective is that research findings on differences in perceived safety, interacting with the physical environment and gender, are inconclusive. One example is the effect of CCTV surveillance. While research has shown that overall perceived safety increases with the presence of CCTV surveillance, others argue the opposite effect for women. Koskela (2006) shows, for instance, that concealed surveillance (either the cameras or the control rooms) erodes women's confidence and may affect perceived safety. This was already indicated in early 1990s in a U.K. study (Trench et al. 1992:291) where CCTV cameras at platforms and bus stops seem to offer little comfort to women. Loukaitou-Sideris and Fink (2009) indicate examples that street lighting has a positive effect on women's fear. They also show that women seem to have mixed reactions to segregated transportation schemes (e.g. Khimm 2006; Lynch and Atkins 1988).

Gender differences in stated personal safety may be related to the fact that women and men are travelling in different ways. The truth is that women still hold greater responsibility for childcare, care of the elderly, and household chores – activities often limited to the private sphere or places close to home. When compared to men, women in urban areas tend to take more, shorter, and more varied trips at more varied times, but they tend to travel less during nighttime and avoid dark places. Research has also suggested that men travel long distances and use the car more frequently, while women travel shorter distances and use public transportation more often. However, new evidence questions this common assumption. Recent studies in Sweden show that gender differences in travel patterns are marginal for certain age groups, but that men still tend to travel by car more often than women. Small differences are found between men's and women's bus travel. Young women tend to take even slightly more car trips than men (Trivector 2010). Regardless of the choice of transportation mode and/or journey length women are more likely to have multiple purposes and multiple destinations within one trip (Kunieda and Gauthier 2007), which imposes specific needs for transportation and urban planning.

Gender is, however, not the only factor that affects perceived safety. Research also finds that feelings of insecurity typically increase with age, partially because of the inevitable increase in individuals' physical vulnerability. Previous research has shown that while young people are statistically more at risk of being victimized, older people tend to be more fearful. A study in the USA finds a strong association between neighborhood safety and physical inactivity among older adults (controlling for race and education) (CDC 1999 quoted in Loukaitou-Sideris 2012).

In Sweden, although the elderly represent only 18 percent of the population, more than two-thirds of all fatal accidents occur among them; more than half of these accidents take place around their homes (Torstensson et al. 2011). A number of studies indicate that elderly persons who live in violent and deteriorated urban environments are more likely to fearful (particularly in the evenings) compared with those living in better-off areas. It is often at home or in the nearby environment that the elderly are vulnerable to crime. According to Aromaa and Heiskanen (2008), the most common types of crime against the elderly in Sweden theft in the home and robbery. One factor that seems to be important for perceived safety is familiarity with the area and with the transportation mode. In the U.K., those who frequently use public transportation feel safer than strangers and infrequent users (U.K. Department of the Environment, Transport and the Regions 1996).

Women and older people tend to be regarded as more fearful than men and younger people, but this perception is inaccurate according to the international literature (Pain 1995). As previously suggested, fear is also influenced by other, more multi-scale factors (national, global) that reach individuals in their daily lives through, for instance, the media (Smith and Pain 2009; Day 2009). More difficult to explain is how these multi-scale factors affect women and men differently. There is also the fact that perceived safety vary within groups; for instance, ethnic minorities tend to be more fearful than the native population (for a review, see Smith and Cornish 2006). Sandercok (2005) argues that expressions of fear of crime are actually expressions of fear of difference (fear of others). In the U.K. (Crime Concern 2004), ethnic minorities, those with disabilities, and the elderly more often express safety concerns at transportation nodes and on the way to/from them.

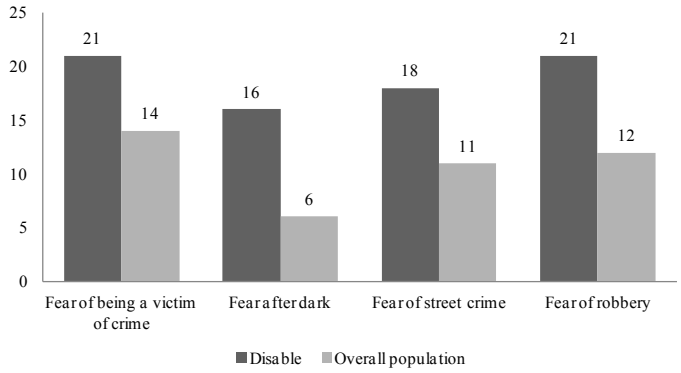


Figure 5.4 – Victimisation and fear of crime among the disable (%), 2011.
Source: Based on 2011s Stockholm Safety Survey, 2012:45.

Disability also affects safety and vulnerability to crime (Figure 5.4). In Stockholm city, those who feel that they have one or more disabilities state twice as much as being victims of assault and robbery than the general population. They

are also over-represented in terms of exposure to domestic violence, threats and sexual harassment. Individuals with disabilities experience anxiety and fear of being a victim to crime. Three times as many say they are worried or do not go out after dark where the live because they are afraid of being exposed to crime.

5.3 The temporal dynamics of safety

Since the 19th century, researchers have investigated time variations of crime. Quetelet (1842) finds, for instance, that the greatest number of crimes against a person is committed during summer and the fewest during winter. Since then, new empirical evidence on how crime levels vary over space and time have either confirmed or refuted Quetelet's findings (for a review, see Cohn 1990; Cohn and Rotton 2003a, b; Ceccato 2005; Uittenbogaard and Ceccato 2012a; Carbone-Lopez and Lauritsen, 2012).

What is confirmed is that researchers often relate these temporal differences to the variations in people's routine activities (Cohen and Felson 1979) and to the influence of weather on behavior (Anderson et al. 2000). The idea is that changes in the weather (or extremes in temperature and pressure) function as *stresses*. Thus, individuals who are highly sensitive to changes in the weather might exhibit behavioral or mood changes, leading to a criminal acts (Cohn 1990). To analyze this, Anderson et al. (2000) formulate the General Aggression Model (GAM), based on the assumption that weather variables (temperature in particular) heighten physiological arousal and lead to aggressive thoughts and, in certain cases, violence. Although most of the literature indicates that more violent crimes occur on hot days (e.g. Dexter 1899; Hakko 2000; Rotton and Frey 1985), there might be a temperature threshold that triggers the reverse behavior. In other words, people's motivation to engage in aggressive behavior is reduced as a result of the need to avoid the heat. This is consistent with Baron and Bell's (1976) negative affect escape (NAE) model that suggests that moderately high temperatures cause negative affect (which leads individuals to behave more aggressively), while very high temperatures result in an attempt to escape the situation and engage in activities that reduce discomfort. The precise point at which temperature becomes uncomfortable is not clear (Hipp et al. 2004) and certainly depends on the yearly average temperature of the place.

Crime variations might also be related to the rhythm of human activities, which was first captured by routine activity theory (Cohen and Felson 1979). As suggested previously, the theory proposes that an individual's activities and daily habits are rhythmic and consist of patterns that are constantly repeated. Song et al. (2010) found, for instance, a great predictability in user mobility across population groups and regardless of the distance covered. This regularity means that one can extrapolate patterns of movement by groups over space and time. Such behavior is influenced by changes in the environment. The effect of weather overlaps the im-

pact of temporal variations on crime since weather determines the probability and intensity of routine activities.

There is evidence from time-budget studies (see Petland et al.1999) that human activities, including victimization, relate significantly to temporal variations such as weekends–weekdays and holidays (e.g. Cohn and Rotton 2003a,b). These are both considered the basis for explaining the mechanisms behind seasonal (summer–winter) and weekly (weekend–weekday) variations of crime over space and time.

This can easily be exemplified by the activities of two people who have different routine activities, but work in the same building and share some time at the subway station on the way to work:

> Rose and Paul work at the same building in town. Rose is a working mother. She wakes up at 6:45 am every morning. After breakfast, she prepares her children for school. At 8:05, they all leave the house and head to the children's school, which is two blocks away from the subway station. Although Paul commutes one hour from a neighboring municipality to the station, Rose meets Paul at the station and they catch the same train at 8:40. They both arrive at work at 8:55 and do not leave the building until the end of the day. Paul heads back home at 3:30 pm as he meets a client in his hometown. Rose meets her children at home at 5:45 pm after buying milk at the supermarket on her way home. Despite any eventual variation (e.g. a trip, illness, or unexpected event), the patterns of movement of both Rose and Paul repeat with some regularity from Monday to Friday.

The regularity of movement patterns illustrated by the cases of Rose and Paul are also found for other societal groups. Figure 5.5 illustrates *two slices* of aggregated data of the total population in the city of Stockholm. Although these data samples are cross-sectional, they illustrate the population distribution over time. Stockholm shows signs of being monocentric, concentrating large shares of the population in the inner city areas during the day. The Central Business District (CBD), together with offices, restaurants, and transportation nodes, attracts more than eleven thousand inhabitants in some parts of the center. As well as government and ministerial buildings, the area also contains the major shopping amenities of the city, theaters, cinemas, museums and bars. All subway lines pass through the Central Station, which is also the main railway station in the capital, making this area a place that many travelers and workers pass daily.

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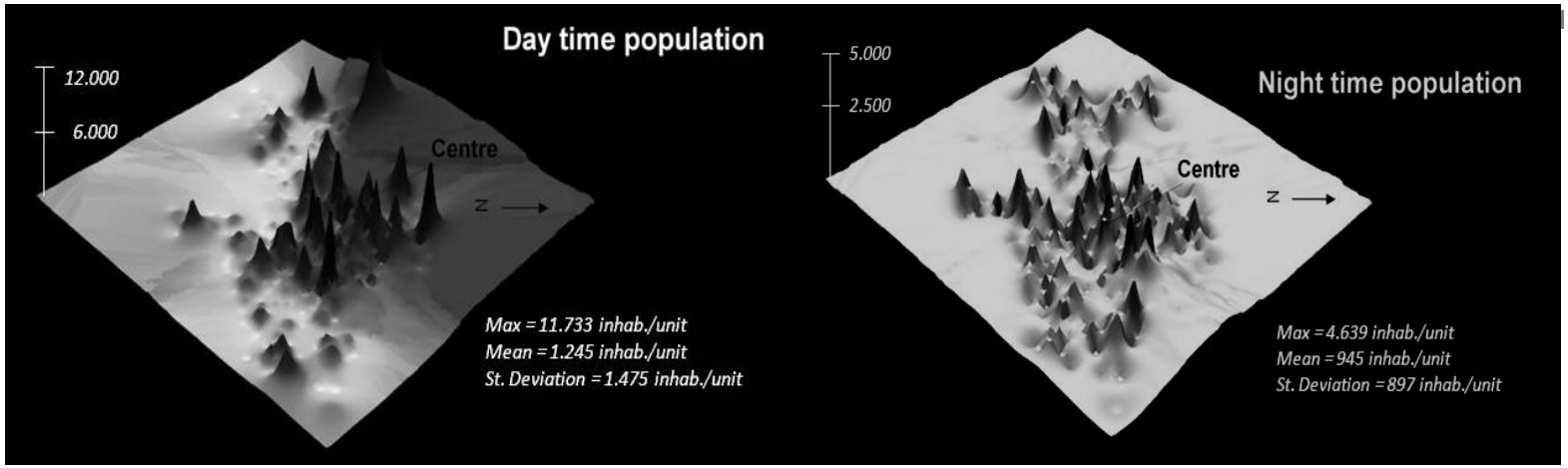


Figure 5.5 – Distribution of night and day time population in Stockholm municipality.

As expected, after work hours, the population becomes more evenly distributed across the city, since individuals go back to their residences. Note, however, that the inner city areas are still alive. One of the reasons is that people reside in the inner city areas; large parts of Stockholm's inner city are residential areas with high housing standards.

The search for patterns of human behavior allows for the discovery of complex interactions between space and time and their joint effect on the structure of human activity patterns, and on localities in particular (Kwan and Lee 2003). This perspective has been particularly useful for understanding people's vulnerability to crime in relation to their routine activity.

The risk for crime is dependent on people's *rhythmic* movement patterns: rush and off-peak hours, weekdays and weekends, winter and summer (Loukaitou-Sideris et al. 2002; Smith and Cornish 2006; Ceccato et al. 2011a). This means that any type of human activity is limited by the amount of time available each day. Time is both a necessary condition and a constraint for an activity. In this sense, committing a crime is an example of an activity like any other. As Felson (2006:6-7) suggests:

> The daily life of a city provides the targets for crime and removes them. The sleeping, walking, working, and eating patterns of offenders affect the metabolism of crime....We must study these rhythms of live if we wish to understand crime.

Understanding the rhythms of crime is also important for police investigative work. The information about offenders' whereabouts over space and time has proven to be useful in finding criminals. By identifying the offenders' modus operandi, place of residence, and offence location, police forces can narrow down the number of suspects – a process called geographic profiling. This technique assesses the behavioral, social and psychological aspects of the offender, considering that certain personality types exhibit similar behavioral patterns, and that knowledge of these patterns can assist in the investigation of the crime and of potential suspects (Rossmo 2000). For tactical police work, this means that this type of knowledge enables practical crime prevention solutions that are tailored to specific places (Ratcliffe 2010:5). In cities where there is large variability in crime rates, targeting resources in the *right area* may be challenging for police officers and other experts working with the strategic distribution of resources directed towards safety. The use of GIS is also an essential part of the analysis of the victims. In an ongoing study using GIS and spatial analysis, Ceccato (2012b) analyses the nature of places where one-third of rapes occur in the Swedish capital of Stockholm. Patterns of spatial regularities of rape locations and victims' mobility are geographically compared with places in the urban landscape that women commonly fear.

An innovative example of spatio-temporal analyses is the study by Herrmann (2013) in Bronx, New York. Using micro-level crime analysis methods, such as Kernel Density Estimation and Nearest Neighbor Hierarchical clustering, Herrmann shows how different crimes have different space and time signatures.

Along the subway stations, for instance, the analysis indicated that robberies were concentrated in some specific parts of the subway lines when it was school days and in others, when children were not in school. These findings confirm the importance of taking people's routine activity into account at very detailed space-time scale.

Rhythms of activities were also fundamental in the study by Wikström et al. (2010) who incorporated information on individuals' exposure to urban environments to predict offending. Although spatial data were collected using traditional frameworks (a computer-based survey), GIS is used to visualize the individual activity fields of 700 children in Peterborough, U.K. In Ceccato and Wikström (2012), children's mobility is shown in different ways using time-geography principles and GIS, and information of the children's whereabouts is used to predict the influence of environment over time on the decision to offend. They also used information about an individual's propensity and exposure to a criminogenic environment/setting to predict the impact of environment on offending. A risk setting for criminal involvement for an individual has been defined as a setting in which the individual spends time in a public place, unsupervised (i.e. no significant adults present), together with peers, and engaging in a non-structured activity. Environmental risk is composed of summed hours of exposure to both risky settings and/or risky neighborhood contexts (e.g. high-crime areas). This gives a weekly environmental risk score for the individual based on the risk characteristics of the settings in which the individual has taken part. Findings show that children differ in their individual propensities for crime, in their time spent in behavior settings, and in their environmental contexts. Individual characteristics interact with risky environments, which explain close to 28 per cent of offending in the sample (self-reported offences). These findings flag for a differentiated effect of environment on individuals over time, but also indicate that the spatial scale on which environmental risk is measured is important in capturing the environmental effect on the individual.

In summary, the framework presented in this chapter relied on examples of the best evidence of the tools and data are available today and to what extent they can be used to inform us about patterns of crime and fear in transportation nodes. What is known is that the risk of being a victim of crime is not randomly across the transportation system. Crimes tend to occur in particular geographical areas in a city; they may occur at certain hours of the day and even in association with specific demographic, land use, and socioeconomic aspects of the population. How individuals perceive risk and fear in outdoor city environments is also space-dependent. Littered places, with clear signs of lack of social control, are often associated with high levels of fear. Information on where and when things happen has been an important element in the discovery of these patterns of regularities of both crime and fear in city environments. Equally important has been the use of this information for planning purposes, particularly when the goal has been to target resources more precisely to tackle unsafe places and formulate preventive actions.

Before the Stockholm case is presented in the next chapter, there are old and new issues worth to be mentioned when working with safety in transportation nodes. The first issue relates to data availability and the quality of official crime statistics at the stations, such as underreporting, biased data sources and poor geocoding. The second issue concerns the selection of the appropriate technique in relation to the application's goals, which relates to the choice of theoretical framework guiding the analysis. The third issue is related to the lack of appropriate data availability and methods to track human activities in space and time. Data permitting, a future application could be to alter people's perceptions of crime incidence and moderate their safety fears in particular stations and at certain times. The next chapter discusses how these issues on data and methodology were dealt with in the Stockholm case study.

Chapter 6
The Stockholm's subway stations

Stockholm is one of the most accessible cities in Europe[12]. This Scandinavian capital received the *2013 Access City award for disabled-friendly cities*, a third place after Berlin and Nantes, France. The European Commission's motivation of the prize reads:

> …chosen for its long-term, inclusive approach following Design for All. The *Vision Stockholm in 2030* aims to turn the city, where 30 percent of the central area consists of water, into a world-class city accessible to all. Good examples include accessible pedestrian crossings, public toilets and playgrounds to ensure that they are accessible to children and parents with disabilities.

The award is given to the city that has demonstrably improved accessibility in fundamental aspects of city living, such as the built environment and public spaces, transportation and related infrastructure, information and communication, including Information and Communication Technologies (ICTs), public facilities and services. The criteria require that the city is committed to carry on improvements in accessibility in a sustainable way, can act as a role model, and encourage the adoption of best practices in all other European cities[13]. Stockholm also received the *Intelligent Community 2009* award from the Intelligent Community Forum. ICT is increasingly used in the city's communication with citizens. Extensive accessibility programs have been conducted in Stockholm, but challenges still remain (City of Stockholm 2010).

This chapter presents some of the most relevant characteristics of the city and its transportation system, with focus on the subway system, as background for further analysis in the next chapters. Here issues on data availability, collection and quality are discussed. A brief review of the methods adopted in the Stockholm case is also presented.

6.1 Framing Stockholm as a case study

Life in a northern city is inevitably affected by low temperatures, which imposes particular challenges for the transportation system. Human activities follow established rhythms of working hours, but are influenced by seasonal variations of daylight, which varies widely from more than 18 hours around midsummer to only around six hours in late December.

The municipality of Stockholm (*Stockholms stad*) has a population of 871,952 (2011), spread over 188 square kilometers, while the Stockholm metropolitan area

[12] http://europa.eu/rapid/press-release_IP-12-1309_en.htm?locale=en, 19th December 2012.
[13] http://ec.europa.eu/justice/discrimination/disabilities/award/index_en.htm, 19th December 2012.

is home to approximately 22 percent of Sweden's population. As a municipality, the City of Stockholm is subdivided into district councils or boroughs, which carry the responsibility for primary schools and social, leisure, and cultural services within their respective areas. Stockholm also has 29 advisory councils that monitor issues from the perspective of persons with disabilities. These advisory councils participate in operational planning and monitor planned activities in cooperation with the Disability Ombudsman. The municipality's formal cooperation with disability organizations, which play a strong role in planning and monitoring, is conducted primarily via the municipal advisory councils responsible for issues involving barriers for persons with disability problems.

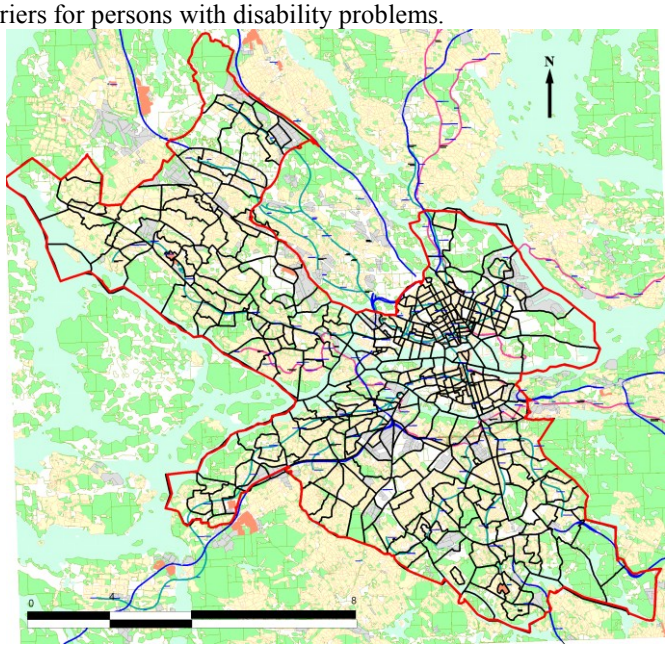


Figure 6.1 – The Stockholm municipality.

Stockholm is part of an archipelago; therefore, water occupies a large part of the urban landscape as the city is spread over a set of islands on the East coast of Sweden (Figure 6.1). The central parts of the city consist of fourteen islands. A third of the city area is composed of waterways and another third is made up of parks and green spaces. The islands (and the county) are well connected by roads and an extensive and efficient public transportation system, comprised of buses, trams, the Stockholm subway system, regional and suburban rail, and archipelago boats. Since 2007, Stockholm uses a congestion pricing system on a permanent basis and the city center is within the congestion tax zone. All vehicles entering or exiting the congestion tax zone, with a few exceptions, have to pay 10–20 SEK[14] depending on the time of day. Stockholm's extensive public transportation system

[14] 1 USD = 6.43 SEK, about 1.50-3.0 USD.

is one of the most expensive in the world. It costs 30 SEK for a single journey of 10km on public transportation (from the city centre, 10km covers nearly the whole municipality), the highest cost in a study of 73 cities by UBS, a Swiss bank. London is not far behind (The Economist 2009). Stockholm Public Transport Company has a common ticket system for the entire county, which allows for easy transfers between different modes of transportation.

The main public transportation junction is located in the Central Business District (CBD) area, in the central area of the inner city. All subway lines pass through the Central Station (*T-Centralen* subway station, railway and bus platforms), which is the main railway station of the capital, making this area a place where many travelers and workers pass daily. The Central Station is the only station connected to all three subway lines. According to SL's Annual Report (2006), on a normal weekday, the flow of people travelling to and from the Central Station is around 215,000 people. This place is an area of convergence. Also, the central square (*Sergels torg*), and one of the main meeting points of the city, is a relatively high criminogenic area, where violence and drug-related offences tend to be concentrated (Ceccato et al. 2002).

Overall, large parts of Stockholm's inner city are residential, where citizens enjoy high housing standards. Although other types of housing tenancy can also be found in the inner city areas of Stockholm, privately or cooperatively-owned apartments dominate. The last two decades have been characterized by increasing population density in the central areas, as it is well-connected with public transportation and highly valued in the market. The suburbs of the municipalities are places with diverse cultural backgrounds, which is also the case of many Southern municipalities of the Stockholm metropolitan area. Some areas have high percentages of immigrants or second-generation immigrants. These mainly come from the Middle East and former Yugoslavia, but there are also immigrants from Africa, Southeast Asia and Latin America. Other parts of the inner suburbs have a majority of ethnic Swedes.

Municipal provision of accessibility services

Stockholm municipality has actively strived to provide accessibility for all by implementing tangible changes in the urban environment and by defining legislation to ensure accessible urban environments in all new constructions. The design principles have been compiled in a manual entitled *Handbook for the Design of an Accessible and Usable Environment* as well as in the report *Stockholm – a City for Everyone* (City of Stockholm 2010). The manual is based on Swedish planning and building legislation and was prepared in cooperation with disability-related organizations.

Since 1999, a number of changes that improved people's accessibility have been carried out, which was under umbrella of *The Accessibility project*. For ex-

ample, 65 percent of the inner city's and 25 percent of the suburban areas' pedestrian crossings were rebuilt. The pedestrian crossings feature curb cut ramps for persons with disabilities and contrast markings for visually impaired persons. Deep, cross-pavement drainage channels across sidewalks were replaced with new, shallow, rounded ones to facilitate wheelchair movement. The first and last steps of 1,500 stairways were contrast-marked and new railings on stairways and along sloping footpaths were supplemented or constructed. Accessible public toilets were built in public areas. A large number of children's playgrounds were refurbished to ensure that they are accessible to children and parents with disabilities. Fundamentally, vertical height differences at entrance doors were improved in conjunction with the renovation of city squares and pavements. Lighting and benches along footpaths, sidewalks, and in squares were also part of the program (City Executive Office 2011).

With regards to public transportation infrastructure, about half of inner city bus stops and a fourth of suburban ones have been rebuilt in the last decade (bus stops have gained higher curbstones and contrast markings). All buses are equipped with internal communication systems and automated announcements of the next bus stop through both speech and text, as well as external communication of the bus route as it pulls up to the bus stop. Tracks have been adjusted in 89 of 100 subway stations to minimize the vertical and horizontal gaps between the cars and platform (all stations will be completed in 2013). Manual ramps were installed on commuter trains to cover the gap between the car and platform; train attendants are responsible for extending the ramp. This service is offered to wheelchair-bound travelers both on a pre-ordered basis and spontaneously. A personal guidance service is offered to all passengers requiring extra assistance in orientating through the public transportation system. There are about 2,000 digital signs with public transportation information in Stockholm County. The digital information is supplemented with audible information that is helpful for visually impaired travelers. The City's public documents are to be accessible as well. The City's website can be listened to or downloaded as MP3 audio files, and some 33 videos are available in sign language about these accessibility projects. Reference groups with functionally disabled representatives give input on the website's maintenance, design, and additional launches of e-services. Representatives of disable organizations have also been involved with the *e-Adept* and digital pedestrian network projects that have focused on developing pedestrian navigational aid for visually impaired and elderly persons (City Executive Office 2011).

Service provision towards the elderly and disabled is strongly linked to the basic political platform of welfare services in Sweden and therefore embedded in the existent sectorial administrative policies. This means that there are no special institutional housing for people with disabilities. According to the City Executive Office (2011), about ten thousand individuals receive support in their own apartments or for small group of individuals. About 26,500 elderly persons receive homecare, of whom 6,000 are in residential care facilities. The system of housing choice offers the possibility to select service donor. The alternatives are presented

on the municipality's website. Relatives can follow the service their elderly loved one receives through an e-service and telephone (The Care Diary, *Äldre direct*).

Housing services are ranked, as well as the program for accessible outdoor environments based on specific criteria and users' satisfaction. Accessibility audits of 80 sport facilities have been conducted (13 of 16 swimming facilities offer full accessibility and 22 of 27 are accessible). Several theater performances offer audio descriptions, subtitling, and audio technology assistance. A special library offers audio books, e-books, Braille books, tactile books, and most libraries have free home delivery service of books for the visually impaired.

The subway system

The Stockholm subway system is the 20th longest in the world with a track length of 110 km. More than one million trips take place every day. The Central Station (*T-Centralen* subway station) has the largest number of passengers per day, around 161,000 people (MTR 2012). The system is composed of 100 stations, of which 47 are underground (mostly in the central city) and 53 above ground. There are three lines: Green, Red and Blue (Figure 6.2). The case study in this book reports on crime and public disorder events in the entire Stockholm subway system, but because of data limitations, the modeling section utilizes data from 82 percent of the stations (the ones located in Stockholm municipality).

Figure 6.2 - The Stockholm subway system.

The Green line has 49 stations (of which 39 are above ground). It is the biggest line regarding the number of stations as well as number of passengers; it is used by 451,000 passengers per workday. The Red line includes 36 stations (15 above ground) and transports 394,000 passengers per workday, while the Blue line consists of 20 stations (only one above ground), and moves 171,000 passengers per workday. The trains are operated from 5:00 am to 1:00 am. All lines have trains every 10 minutes during daytime, but the frequency is limited to every 15 minutes in early mornings and late evenings, and every 30 minutes during nighttime. During peak hours, additional trains operate every 5–6 minutes in suburban stations, with 2–3 minutes between trains in the central parts of the network (Stockholm Public Transport Annual Report 2006).

About half of the platforms at Stockholm's subway stations are underground. In these stations, sunlight is replaced with artificial illumination often placed in ceilings, walls or floor. Platforms are connected to the lobby are either directly or via a transition area, which may include stairs, elevators, and escalators. In above ground stations in the daytime, the natural light illuminates the lobby through glass windows. There are only ten stations at which the platform is easily visible from the lobby area and vice versa (e.g. Odenplan, Vårby Gård, Hökarängen, and Ängbyplan). Exit areas may include a long tunnel, stairs, escalators, or elevators, with artificial illumination being part of these entrances/exits. In other stations, the open design of entrances often allows natural light to reach the lobby and transition areas. Elevators and ramps have been provided for disabled persons in the most important access areas of the stations (Bamzar 2010).

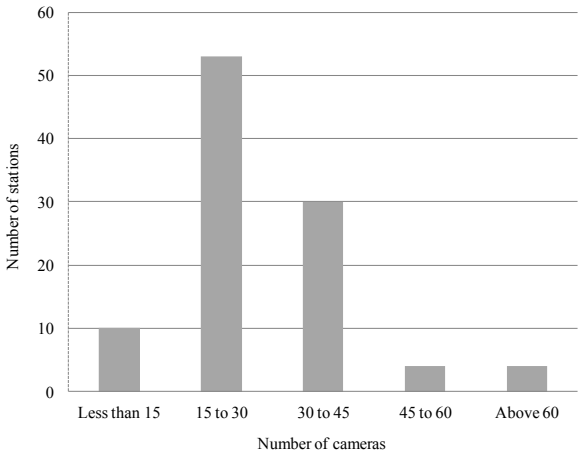


Figure 6.3 – Subway stations by number of CCTV cameras.
Data source: Stockholm Public Transport Company 2010.

There is no subway station with a low level of visibility in all four internal sections, but there are some stations with high levels of visibility in all four sections

(platform, transition area, lobby, exits); Hjulsta, Farsta, Skärmarbrink, Alby, Norsborg, and Fittja all have high visibility in all four sections. Hötorget has been recognized as a station with a high level of visibility in the platform, lobby, and transition areas, while it has a low level of visibility in the exit/entrance area. Skärholmen, with a low level of visibility at the platform, has high levels of visibility in other three sections. Ticket collectors are located in their booths, often enclosed by a glass screen. Ticket gates are found in the lobby areas and are composed of two types: semi- and fully automatic gates (semi automatic gate is composed of a bar that rotates down while fully automatic gate is constituted by tall glass doors that open automatically as the passenger approaches the gate). With the first type, there are still opportunities for fare-dodgers. In some stations, a mix of these two types is in place. Semi-automatic gates are found in eighty-one stations, while sixteen stations have fully automatic gates, and five stations have a mix of both types. Kista, Rådmansgatan and Vällingby are examples of the stations with fully automatic gates and Hötorget, Mariatorget, and Skanstull have mixed types (Ceccato et al. 2011a).

CCTV cameras have been placed in key places in platform, transition, and lobby areas for security and surveillance purposes, while in the entrance/exit, few CCTV cameras have been installed due legal restrictions. According to Swedish law, there must be a clear sign in the places where CCTV cameras are installed. These signs have been installed at the entrances of the subway stations and on the platforms. Figure 6.3 illustrates the number of CCTV cameras by station. The average number of CCTV cameras per station is 29, while the Central Station (*T-Centralen*) stands out with most (127), and Blåsut, Sandsborg, and Stora Mossen with the least (10). Some cameras in each station are not visible from the passenger eyesight.

Table 6.1 – Number of services near subway stations in Stockholm municipality.

Services	Within 100 meters	Within 200 meters
Cash machines (ATMs)	61	105
Alcohol stores	12	24
Police stations	5	8
Schools	21	65

Source: Ceccato et al. (2011a).

Security mirrors are used when the place managers or security guards wants to perform surveillance in a certain area without been there. This is achieved by having a partially reflective surface on one side, but none on the other side. Sixty-one stations have no mirror in place, while five stations (Åkeshov, Tallkrogen, Gubbängen, Örnsberg, and Bredäng) have it in both the lobby and transition areas.

Other environmental features that may have an effect on the criminogenic conditions of the station and/or safety are presence dark corners, potential hiding corners and seats. Vällingby is the only station with dark corners in all sections. In

addition, Stadion, Hagsätra, Medborgarplatsen, and Gamla Stan have potential hiding places in all four sections. Only in Västertorp seats are available in all sections, while in Hökarängen, on the contrary, is the only station with no seats in any section (Ceccato et al. 2011a).

The field inspection performed by Ceccato et al. (2011a) shows that in fourteen stations, elevators in both lobby and transition areas are smelly or have graffiti (e.g. Fridhemsplan, Vällingby, Råcksta, and Gullmarsplan). Nine stations have neither elevator, nor access for strollers or wheelchairs (e.g. Blåsut, Sockenplan, and Vårby Gård). Farsta Strand is the only station that has a low level of visibility and surveillance on its platform, as well as having dark corners, hiding places, and non-effective illumination. Furthermore, the presence of littering and other physical deterioration on the platform was recognized at the time of inspection. The transition areas of Kungsträdgården and Gullmarsplan stations are the only two with low levels of visibility and poor illumination as well as the presence of hiding places and dark corners, all four at the same time.

The presence of some features in the stations' surrounding areas was included in the field inspection. For instance, there are 58 stations with bars in their surrounding areas and more than 80 with restaurants. Using GIS and maps, similar figures were found for schools (Table 6.1).

In the next section, issues of data collection and quality are presented followed by a brief introduction to the methods used in this case study.

6.2 Data and method

Data quality is still an important barrier to both research and planning in safety. In the UK, for example, a large share of crime on public transportation is not reported. Reasons may include a reluctance to delay the journey, a lack of confidence in the police or other authorities to catch the offender, a lack of personnel to register the report. Abuse, harassment, intimidation and other types of verbal assault (e.g. being stared at, followed, pestered, or shouted at) can be unpleasant experiences and are even less likely to be reported because they may not be criminal (U.K. Department of the Environment, Transport and the Regions 1996). It is believed that similar data problems, regardless sources, may also be found for the Stockholm databases.

Other possible sources of inaccuracy include lack of information about the event from the victim or because the police officer fails to record the event properly. Data quality may also be affected by handling procedures, such as poor geocoding (Ceccato 2013). Data recorded by personnel tend to reflect particular targeted actions that may bias the 'real' distribution of events at the stations (more events of a certain type to the detriment of others). This includes particular programs against activities that take place at the station, which are perceived as disturbing for passengers, resulting in the end, in more records. For instance, more than half of all records of acts of public disorder are composed of people using

station premises to sleep or showing signs of drunkenness – a category that has increased over time, perhaps indicating that the tolerance for these events in public spaces is now lower than it was in the past. On the other hand, acts of public disorder rarely reach police statistics as victims tend to report an event to the police only when they themselves feel victimized, which rarely includes vandalism and disorder (Ceccato et al. 2011a).

Crime and public disorder data were gathered from Stockholm Public Transport (2006-2009) in combination with police-recorded statistics (2008) obtained from the Stockholm Police Headquarters; x,y-coordinates and dates for all types of offences. Despite having x,y-coordinates, it was not possible to know exactly when and where the event occurred in relation to the journey (e.g. during the trip, at the station, in the subway car, or on other nearby premises).

The Stockholm Public Transport database used includes 62,265 reports for three years from the first of March 2006 to the end of February 2009. The database can be sorted by date, time, location, and crime type. Robbery, burglary, theft, vandalism, threats, violence, drugs and alcohol abuse, and other crimes were extracted using SQL functions in GIS. Instead of using crude data of number of crime events per station, crime rates per 1000 passengers were calculated based on the passenger flow at each station. To make inferences about what happens at each station and its surrounding area, a set of buffer zones were created from the x,y-coordinates of each station.

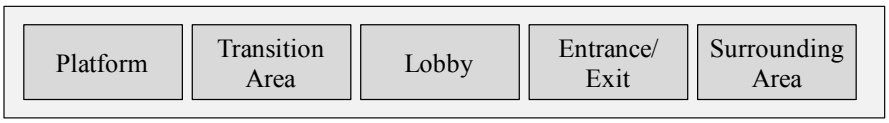


Figure 6.4 - The inspection of five sections of the subway stations.

The environments of subway stations follow some common standards (e.g. illumination, gates, real-time train timetables, and platform/lobby structures), but they differ from each other, which potentially impacts the stations' vulnerability to crime and disorder. In order to assess these differences, a systematic and detailed *inspection* of all subway stations in the Stockholm subway system (including photographic documentation), as well as a check of their surrounding areas was conducted. The detailed attribute checklist was created and pre-tested at a couple stations. The inspections were based on fieldwork observations of five parts of the stations (Figure 6.4). In the summer of 2010, all subway stations were inspected on a weekday, between 10 am and 4 pm, thus avoiding a-typical hours (peak hours and busy weekends). In November, stations were revisited in the evening/weekend to get a better idea of specific features, such as illumination, at each station. This second wave of fieldwork was also helpful in checking whether or not there were any major differences in the social environments of the stations (e.g. problems of social order) between days (weekdays) and evenings (weekends).

The inspection followed the model suggested in chapter 5. The station platform is constituted of the platform, where the trains arrive and passengers wait, while the transition area is the area in between the platform and the gates/ticket booths, and commonly includes stairs and elevators to the platform. The lobby is the area between the gates/ticket booths and the exits or tunnels. The exits are areas limited to entering the lobby area, either directly from the street or via a tunnel. The surroundings included the immediate surroundings around each exit, i.e. the field of view from a station exit.

Stations were inspected using a common template. Similar checklists were applied to platforms, transition areas, entrances and surrounding areas. For instance, for all stations, the visibility and possibility of surveillance were assessed; any dark places or vandalism was noted. The presence of security cameras and guards, drunken people, overall crowdedness was checked. Area-specific features were, for example, seats, elevators, types of entrance gates, cash machines, and type of walls.

Visibility, potential for surveillance, pleasantness, overall crowdedness, and smell in the elevators were assessed using a low-medium-high scale. Visibility was defined as *how much one could see from the location*, thereby giving an inside-outside perspective (you in relation to others). The second, surveillance, was defined as *how well others can see you*, thus providing the outside-inside perspective (others in relation to you). The pleasantness of the area was classified as *does one feel comfortable and is it a nice place to be?* Crowdedness was classified as low for 0-5 people, medium for 6-10 people, high for more than 11 people in each section of the station. Smell was subjectively categorized as low, medium, or high by the presence of graffiti and strength of smell from, for instance, urine. The surrounding features, (e.g. the presence of shops, bus stops, parking, ATMs, bars, motorways, parks, littering, drunken people, etc.) were checked, including in which type of immediate surrounding the station was embedded, such as residential, commercial, or mixed. Data from the fieldwork inspections (checklists) were input into Excel sheets and then imported into Geographical Information Systems (GIS) together with data on land use, crime, and demographic and socio-economic features of the population.

In addition to the checklist, five standard, written questions could be asked to passengers, ticket issuers, and security guards. During the visits, 105 passengers, 66 ticket issuers, and 5 security guards were asked their opinions about crime at stations and their perceived safety.

Data on crime and disorder

Stations and crimes were mapped as point data, while the Stockholm demographics and socio-economic data were linked to base unit (*basområde*) statistics (Figure 6.1). In order to assess the influence of the surroundings on crime and

disorder events at each station, a number of criminogenic land use indicators were manually mapped: the locations of ATMs, schools, police stations and state alcohol stores (*Systembolaget*) in Stockholm. A number of layers were created by searching for the locations on the internet and manually applying a point object in the GIS layer at each particular address.

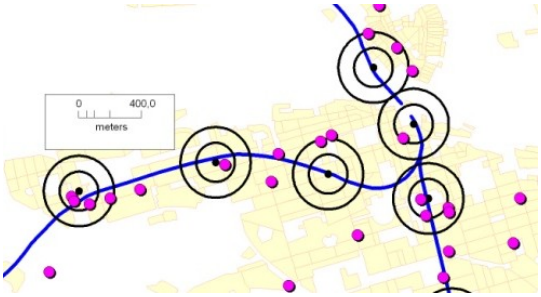


Figure 6.5 - An example of buffer zones in relation to subway stations and to the locations of ATMs.

Moreover a set of two buffers were created for each station's x,y-coordinate: the first one with a 100 meters radius around the station object, and the second with a 200m radius. The 100 meters radius is chosen to include just the station area, in order to more likely correspond to reports from the SL database. The 200m radius includes the surrounding neighborhood as well, not encompassing too big an area, but representing the near surroundings of the station (so as to avoid overlaps between stations located in the city center). Buffer zones were created around the station objects to later calculate how many of the police reports could be assigned to a station, as well as to calculate the proportional population living (total population) or passing nearby to the station (*dagbefolkning*). Figure 6.5 illustrates the size of buffers used in the analysis.

Rates per 1000 passengers for each station were calculated instead of using counts of events. This procedure was necessary to account for the flow of people passing through each station. If only counts are used, the analysis will only reflect the hierarchy of the subway network system, since more events tend to happen where people converge. Although rates are better indicators than counts, they are not problem-free. A couple of stations show relatively high rates because the flow of passengers is low. Furthermore, although Ängbyplan and Stadion stations experience similar levels of violence (around 120 cases), Ängbyplan shows a rate of 46.3 cases of violence per 1000 passengers compared to Stadion's violence rate of 6.4. These cases constitute not more than five out of a hundred stations and are not peripheral from the city center, which, therefore, does not affect the conclusions drawn in this analysis. If a station has a poor flow of people (in relation to the number of events), this can be regarded as a criminogenic factor per se that makes the station more vulnerable to crime compared to others (because of lack of guard-

ianship). Rates for specific time windows (peak and off-peak hours) were created and later modeled in relation to the station's environmental attributes.

Data on perceived safety

The analysis of the perceived safety at subway stations was based on the 2008 Stockholm Safety Survey sent to a sample of households, which was representative for each district. This audit is part of the crime prevention program of Stockholm City and aims at providing information for crime prevention in the various city districts. The overall response rate was 65 percent but varied from 45 to 75 percent in the individual districts. Three questions were selected for this analysis:

1) Are you afraid of being a victim of crime at the subway station closest to your home? (Är Du orolig för att vistas på den tunnelbanestation som ligger närmast där Du bor, därför att Du skulle kunna utsättas för ett brott av något slag?)
2)Are you afraid of being a victim of crime when walking home from the subway station or bus stop during the evening/night? (Är Du orolig för att kvälls- eller nattetid gå hem ifrån en tunnelbanestation eller busshållplats, därför att Du skulle kunna utsättas för ett brott av något slag?), and,
3)Are you afraid of being a victim of crime in your own neighborhood? (Känner Du oro för att bli utsatt för ett brott av något slag i Ditt bostadsområde?).

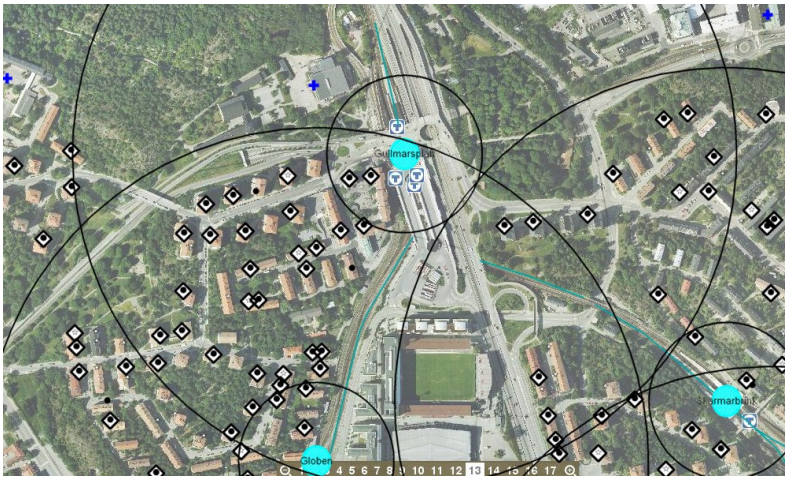


Figure 6.6 - An example of the analysis using data from the perceived safety survey. *Dots* indicate the place of residence of respondents who *perceive the subway station as unsafe*, while *squares* represent those who *perceive the walk to/from the station as unsafe.*

These three questions could all be answered with yes or no on varying scales. Feeling unsafe was classified by answers including *yes, every day*; *yes, once a week; yes, once a month; yes, a couple of times a year; yes, often; yes, regularly*

and *do not use the subway because of worrying about crime* as one category (using code *1*). Feeling safe has been defined by the answer *no, never* feeling unsafe (using code *0*). Other possible answers, like *do not use the subway station due to other reasons*, were defined as not of interest (using code *15*), while unanswered questions or incorrectly answered questions were categorized as unanswered (using code *999*). In order to get a more comprehensive overview of the survey, a cross tab linked these answers to the respondents' background. The three questions were split by gender (male or female), age (young: up to 25 years, adult: 26 to 65 years and elderly: 66 years and older), foreign background (born outside of Sweden or not), type of tenancy (renter or owner), and families with kids (any young children in the family or not). With this procedure, differences between groups can be assessed using Chi-square statistical tests.

Data from Stockholm Public Transportation (SL) Safety Survey was also used for the analysis of perceived safety. The data is based on questionnaires that are distributed and collected on board in a sample of vehicles. The survey is conducted by SL during two weeks of each month from January to May, and August to December, during peak (6-9 am) and off-peak (10 am - 2 pm) hours. Approximately 55 percent of the interviews are conducted during peak hours and 45 percent during off-peak hours. The survey is based on a minimum of number of questionnaires per month, of which at least 2975 questionnaires are administered on buses, 750 on the subway, 960 on commuter trains, and 1250 on local trams. The safety report data, on which this figure is based, includes results from more than 23,000 interviews conducted from January to April. Weighting procedures correct for numbers of boarding passengers per transportation mode and line/branch.

Using GIS software, several buffer analyses were carried out. Multiple ring buffers were used with different distances in order to assess whether there was any effect of distance on perceived safety (Figure 6.6). To check each subway station's perceived safety level as well as which are perceived as unsafe, the number of those who perceived them as unsafe (e.g. station itself, walk to station, neighborhood) was counted and standardized by the total number of survey respondents. Details of these steps can be found in Ceccato et al. (2011a).

Cluster analysis

The Kulldorff's method was used to both detect hotspots of violent and property crime rates as well as rates of perceived (un)safety (Kulldorff 1997). The test uses the Poisson version of the scan test since under the null hypothesis of a random distribution of offenses (with no area-specific effects) the number of events in any area is Poisson distributed. The space–time scan statistic is defined by a cylindrical window with a circular geographic base and with height corresponding to time. This cylindrical window is moved in space and time, so that, for each possible ge-

ographical location and size, it also visits each possible time period. An infinite number of overlapping cylinders of different size and shape are obtained, jointly covering the entire study region, where each cylinder reflects a possible cluster. This procedure is used to ensure data robustness (there is a higher power to pick clusters up with the collapsed data than one year dataset) (Kulldorff 1997).

The Kulldorff's scan test uses space-time statistics and requires the user's input. For instance, for the crime analysis, the input data was created separately for each different run. In order to have an effective but comprehensive data input, all crime records were linked to their respective small unit areas (*basområd*) as defined in the Stockholm population data using GIS (population basis). This implies that the scans are not run based on the exact coordinates of each separate crime record but on the attributes (population) of each pair of coordinates of the small unit areas. In one case, for instance, the maximum temporal cluster size window was set to seven days so that the crime clusters were identified at a maximum length of a week. For spatial limits two ranges were used: one being maximum 50 per cent of the population at risk and the other a maximum of 10 per cent of the population.

Modeling

The Ordinary Least Squares (OLS) regression modeling was used to try to explain the relationships between variables indicating safety and covariates indicating the physical and social environmental conditions of the stations and their contexts:

$$Y = X\beta + \varepsilon \qquad (1)$$

Where Y is the dependent variable vector (crime rate at a particular station or the perceived safety at a particular station), X is the matrix of independent variables (e.g. number of CCTV cameras), β is the vector of regression coefficients, and ε is the vector of random errors with mean 0 and variance $\sigma^2 I$.

As regression analyses are based on the assumption of the independence of explanatory variables, a correlation analysis was used to check if attributes were correlated to each other (when high correlation was identified, one of the variables was excluded from the model, cut off of $r < 0.6$). Moreover, the transformation of the dependent variable was necessary as some were highly skilled (here a natural log was used showing satisfactory results, using checks of the pre- and post-transformation variable distributions). More details of the modeling strategies are discussed in chapters 7 and 8.

Interviews with stakeholders

The empirical material with stakeholders was gathered via interviews conducted in the beginning of the research and at the end in 2012. Semi-structured interviews were carried out with heads of safety and security departments at the main public transportation companies in Stockholm (SL and MTR), experts from the national board of transportation (Trafikverket), civil servants (safety experts and disability ombudsmen), urban planners, architects for a total of 12 individuals. Participants were identified through *snowball sampling* (e.g. Babbie 2010) with key actors in each area who were interviewed and then they suggested other individuals in their respective area. These conversations mostly generated access to written material, presentations, reports, DVDs, photographs, and maps.

The template of the semi-structured interview covered basic information about the person's role in the Stockholm transportation system in relation to safety, the budget directed towards safety and security issues, common problems (areas) identified by each actor, current solutions, characterizations of work done, current cooperation initiatives, perceived hindrances in the cooperation process (e.g. economic, technological, cultural), descriptions of safety-related work regarding the mobility of special groups (e.g. elderly and disabled), stakeholders' own perceptions of the challenges when working with safety using a *whole journey approach*. The questions of the template were adapted to each participant. An example of the template is presented in Appendix 6.1.

How do these environmental attributes of station and surroundings affect safety at these transportation nodes? What is the nature of these events in the Stockholm case? To answer these questions, chapter 7 presents a more detailed analysis of the variation of events at subway stations based on crime rates per station.

Chapter 7
Crime and the environment in Stockholm's subway stations

Stockholm subway recorded 0.05 events of crime and/or public disorder per passenger. Overall rate of crime, as this, are poor indicators of safety, as they do not reflect local and regional criminogenic conditions. It does not explain why certain subway stations concentrate more crime than others. Neither does it explain whether the environment at the station may be more influential than the station's surroundings in accounting for the variation in station crime rates. In this chapter, specific crime rates are calculated based on estimated passenger flow per station and are used as indications of safety at these transportation nodes. Then, variations of crime rates are modeled as a function of the station's environment attributes and their contexts (neighborhood and city).

7.1 Crime and disorder at the stations

Social disorder is the most common type of event reported at stations; around 80 percent of all events. Public disorder events at stations are unlawful activities or acts of anti-social behavior. Examples of *irritating behavior* are, for instance, public urination, drug users and people hanging around, drunken people at the station, and people found sleeping in the subway cars. Other problems include unjustified use of emergency brakes, fire extinguishers, or fire hoses (Figure 7.1).

About 20 percent of reported events at subway stations are more serious offences, often violence (including threats), thefts and vandalism. Property crimes are more often recorded in official police statistics than in Stockholm Public Transport Company's database. The majority of these crimes are fights (about 40 percent), vandalism, and threats, followed by other types of violence. Most reports of violence are against personnel, guards, drivers, or passengers. For robbery, station data show that most reports are made by passengers at the stations. The police robbery data also show a large portion reported at the stations, although the majority of all records at stations is related to places like shops and supermarkets at the station.

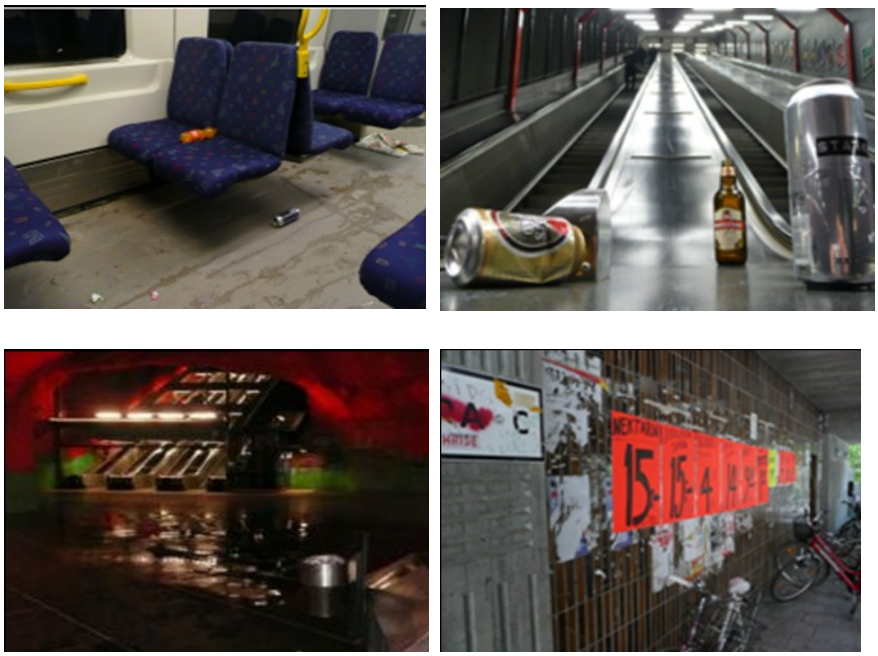


Figure 7.1 – (a) and (b) Littering in subway cars and transition areas during the weekend; (c) A fire hose was used by youngsters as prank in the evening on the weekend. The whole floor is wet and the fire hose hanging out; (d) Unauthorized advertisements at the entrance might give the impression that *nobody is in control*.

Theft at subway stations can generally be divided into two types: theft from persons and of objects. The latter includes theft of bicycles and cars, which is not uncommon around subway stations (in parking lots or on streets) but also shoplifting in shops and food stores.

Table 7.1- Crime rates by subway line in Stockholm[1].

	SL data (a)	Police data (b)
Blue line	0,012	0,019
Green line	0,012	0,020
Red line	0,009	0,013

Data sources: Stockholm Public Transport Company (2006-2009), Police data (2008).

[1] The Central Station (*T-centralen*), Slussen, Gamla Stan, and Fridhemsplan are excluded since they belong to all three lines.

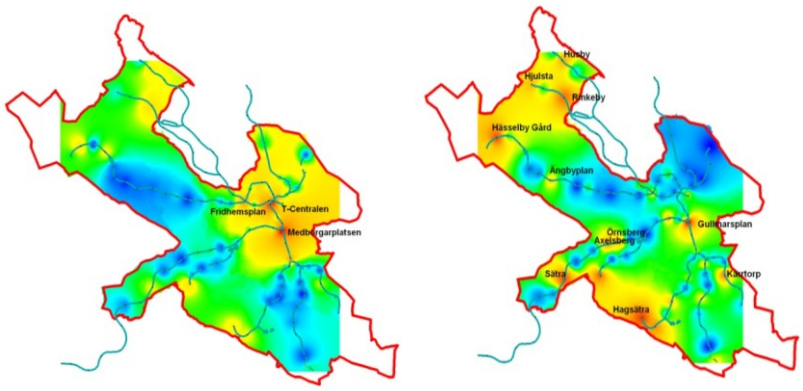
Theft from persons mainly includes goods stolen from subway passengers. According to the police database, these mainly occur at crowded stations. Vandalism is frequent at subway stations. Acts of vandalism include graffiti on walls or floors as well as damaging objects. Often, damaged benches and trashcans are seen at subway stations, along with broken windows or windows covered with scratches from etching. However, one does rarely see vandalism inside the subway trains. If it occurs, personnel clean it up right away (Ceccato et al. 2011a).

What happens at each subway station is influenced by the flow of people passing by over time. If the number of crime events happening at a station is counted, the number of crime events unsurprisingly increases as the number of passengers rises. Table 7.1 shows crime rates by lines in Stockholm.

Individual stations along the Red line show often lower crime rates than the Green and Blue line stations regardless data source. Reasons behind lower crime rates in the Red line compared with the Blue and Green are difficult to make. Length of lines and types of environments they are located are facts that certainly affect the rates. In the next sections, differences in crime rates between stations are discussed.

7.2 The geography of crime at the stations

The Central Station (*T-centralen*) shows the highest number of events in Stockholm municipality, but it does not keep its top position after events are standardized by daily passenger flow (Figure 7.2). Instead of using crude data of number of events per station, rates per 1000 passengers were calculated for the three databases and crime types: robbery, burglary, theft, graffiti, threat, violence, public disorder and other.



(a) (b)

Figure 7.2 – (a) Polide reported violence at station in counts and (b) Police violence rates by day population at station. **Hot colours** = high concentration, **Cold colours** = low concentration. Data source: Stockholm Police (2008) and SL passengers data per station (2005-2008).

The so-called *end-stations* often show higher rates of events (crime and public disorder) than stations located in the inner city areas (exceptions for thefts are the inner city stations Medborgaplasten, Skanstull, and Central Station). Hjulsta, Farsta Strand, Hässelby, Vällinby, and Hagsätra stations show high rates regardless of crime type, but there are some crimes that still tend to be more concentrated at inner city stations, such as property crimes. Thus, the location of the station in the subway system seems to be an important criminogenic factor that helps ex-

plain its vulnerability after controlling for passengers flow (end-stations may show greater passenger flows since these stations are connected to buses and other train lines).

It is also important to mention that this concentration pattern at the end of the lines is associated more with the number of social disorder events at the stations than with more serious crime events. As the station is at the end of a line, there are often reports of sleeping and drunken people still present on the trains and small fights may break out.

Some stations are *crime-specialized*. For instance, stations such as Masmo and Rinkeby more often have problems with violence, while Skogskyrkogården and Västertorp stations more often have high theft rates, and Norsborg vandalism. Some of these stations belong to areas with higher than average general crime rates and often they belong to areas of mixed land use, near to commercial areas, where people meet.

Another emerging pattern is that the more peripheral a station is relative to the city center, the higher violence rates it tends to have. However, for property crimes, the picture is somewhat different. Stations located in more central areas tend to show higher theft rates than those stations located in the Stockholm periphery (Figures 7.3(a) and (b)).

In the next sections, possible reasons underlying this pattern are suggested. Crime rates of the stations are later modeled as a function of environmental attributes as well as of the stations' relative position locally and the city.

7.3 Modeling crime and disorder rates

The study is based on date from extensive fieldwork data, demographic and socio-economic data, crime and disorder data collected at stations, and police crime data. Spatial data analysis in GIS underpins the methodology employed, combined with detailed fieldwork at the subway stations. Since the seasonal variations of light and temperature are notable in Scandinavia, wintertime models were tested using a new set of variables such as illumination, overcrowding, and littering in stations. This section is based on some of the methodology and results previously published in the article:

Ceccato et al. (2011b) Security in Stockholm's underground stations: The importance of environmental attributes and context, *Security Journal*, doi: 10.1057/sj.2011.32.

Hypotheses

Criminogenic conditions at subway stations are dependent on the characteristics of the stations and the environments in which they are embedded (land use and socio-economic contexts) at the neighborhood and city levels.

For the purpose of this analysis, three hypotheses are suggested:

H7.1 – Crime and perceived safety at subway stations are affected by the stations' environmental attributes (station design and social interactions). Different types of crime will reflect different environmental conditions and may vary over time.
H7.2 – The land use and socio-economic context in which stations are embedded has an impact on what happens in the subway stations in terms of crime and disorder.
H7.3 – The subway station's relative position in the city determines its levels of crime and disorder. Since crime is often concentrated in city centers, it would be expected that the more centrally located a station is, the more criminogenic it is.

The modeling strategy is composed of three steps. First, using Ordinary Least Squares (OLS) regression, offence rates at the station are modeled as a function of the environmental attributes and social interactions that happens at the platform, lobby, transition, and exit/entrance areas. Significant variables are selected with a minimum level of 90 percent. In step two, offence rates for each crime type are modeled using only significant variables from step 1. The result is a model for each type of event and data source (the Stockholm Public Transport Company database and the police database). Then, in step 3, to the effects of station surroundings are assessed by modeling offences rates as a function of station's attributes, neighborhood socio-economic context, surrounding land use, and the stations' relative positions in the city. Interaction effects are tested for a number of variables, such as distance to city center or income in combination with other station-related variables, but this strategy does not produce meaningful results. Moreover, modeling center and peripheral stations separately produce poor results and statistically is too limited in terms of number of stations/variables.

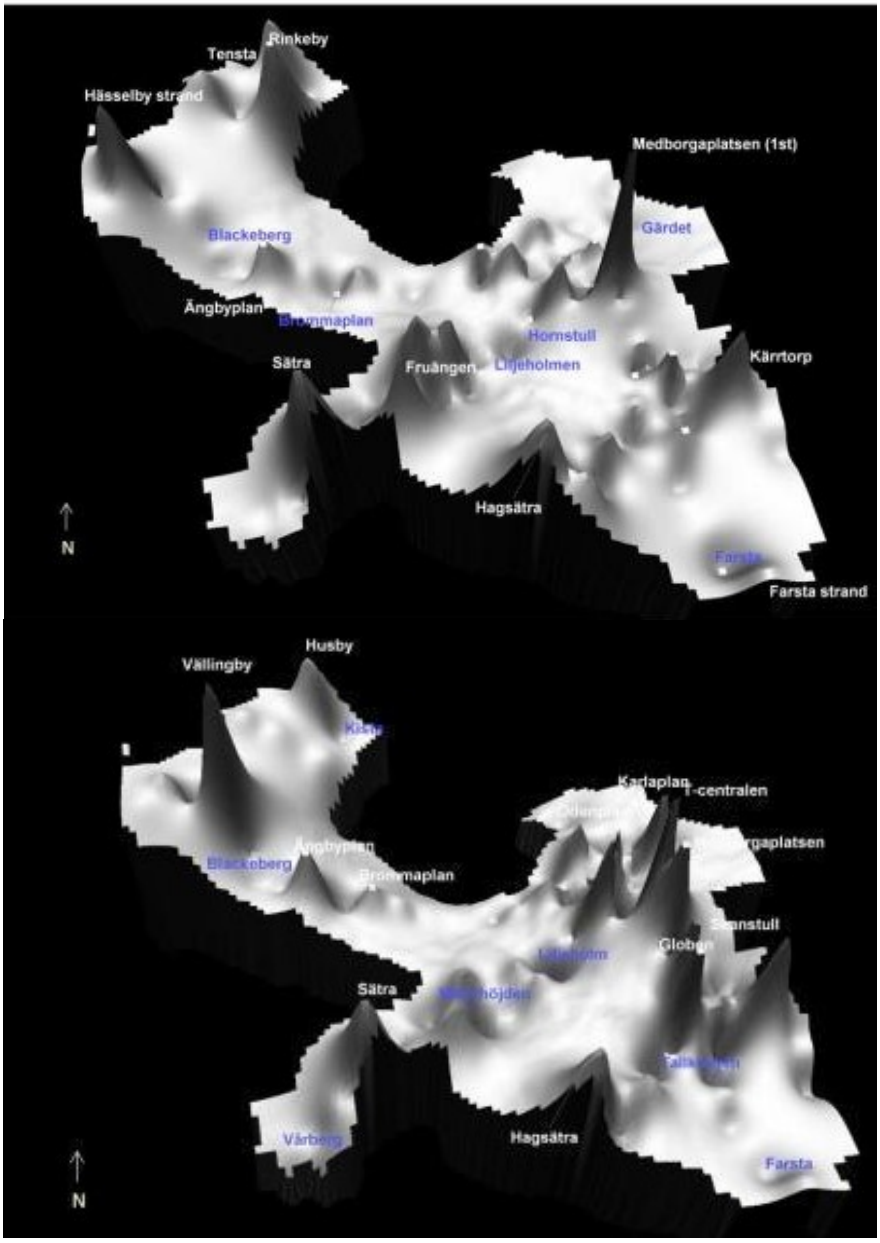


Figure 7.3 – Violence (a) and theft rates (b) at subway stations (100 meter buffer around the station). White text = Hot spots, Blue text = Cold spots. Source: Police data, 2008.

Figure 7.4 illustrates the modeling strategy. The objective of testing several modeling frameworks is to attempt to build a complementary picture of the criminogenic conditions at transportation nodes using different modeling scales (the station and surroundings) and data sources (SL and police databases). Appendix 7.1 lists the police crime codes that are used in the models.

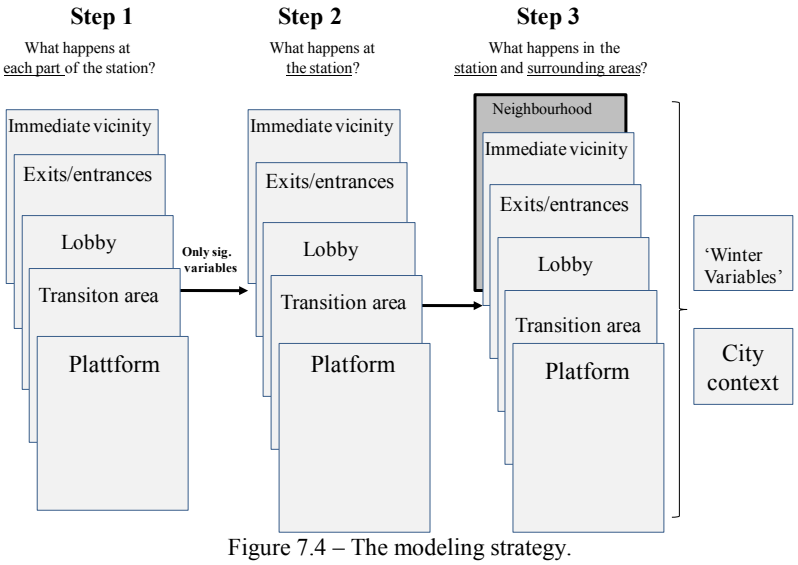


Figure 7.4 – The modeling strategy.

The importance of environmental attributes at each part of the station is first discussed to help explain crime and disorder rates (step 1) followed by models that incorporate the characteristics of the stations attributes alone (step 2). Finally the variables indicating the features of the stations and their neighborhood and city contexts are used as input for the models (step 3).

The importance of the station environment

Across all parts of the stations, variables indicating barriers to formal and informal social control are related to higher offence rates. However, social and physical environmental attributes of platform, transition, and lobby areas turn out to be more important than entrance/exit conditions in explaining the variation in crime and disorder rates at the stations.

According to the modeling results from SL database, high rates of disorder and offences are found at platforms with low guardianship (less crowded), and often in stations with multiple platforms or in transition areas with poor illumination. Lack of illumination in transition areas is often related to high rates of crime and disorder in both database models.

In models based on the police data, platforms seem to be less exposed to crime and disorder when CCTV cameras are present or visible. However, the role of CCTV cameras in transition areas is not clear since the variable either is not statistically significant or shows different signs in different models. The presence of cafés in lobby areas tends to generate fewer offences (SL database). However, shops in lobby areas tend to increase crime, particularly for property offences. The effects of shops and cafés in lobby areas completely disappear in models based on the police data. Indicators of informal social control (number of benches and people, CCTV cameras and their visibility) are more important in explaining the variation of crime and disorder in police data than other variables. The conditions of exit areas and of the station's immediate surroundings have less impact on rates of crime and disorder than do those of platform, lobby and transition areas (fewer variables were significant and signs were not consistent across the crime-type models.

There are a number of environmental attributes of the stations that together affect crime and public disorder rates (step 2). Note that in these models, only significant variables from step 1 were regressed against crime and disorder rates. Results are discussed below and shown in detail in Table 7.2.

Table 7.2 – Station attributes related to crime and disorder.

Variables associated with higher crime rates	Variables associated with lower crime rates
Few people at the station	Good illumination (transition area)
Objects obstructing visibility/surveillance	Less social disturbance
Corners, hiding places	CCTV cameras
High number of platforms	The station's overall pleasantness, littering

Models based on the Stockholm Public Transport Company data show that overall crime, violence, and vandalism rates tend to be lower in transition areas with good illumination and on platforms with many people around. These results also confirm previous evidence found by Harries (1971) and Welsh and Farrington (2007). The number of platforms has the opposite effect. Rates of violence, threat, theft, and social disturbance are higher in stations with more platforms, which is an indication of the size and centrality of stations. The pleasantness of the stations, with fewer observed events of social disturbance (e.g. loud speech/youths messing around) and littering, tends to relate to fewer acts of violence, threats, robbery, and other minor criminal events.

Models based on police data confirm the importance of both formal and informal social control at the stations (more people around, existence of benches), but also indicate the importance of other safety dimensions. For instance, features that might obstruct good visibility and, consequently, affect surveillance (e.g. the presence of physical barriers is statistically significant in half of the models) tend to be associated with higher rates of disorder and crime. The existence of hiding places and corners are significant in models of both violent and property crimes.

Similar results are suggested by Gaylord and Galliher (1991), Myhre and Rosso (1996), LaVigne (1997), Loukaitou-Sideris et al. (2002), and Cozens et al. (2003). More often in models based on the police data than in those based on SL's data, the number of CCTV cameras in the station and their visibility is linked to less crime and disorder. This is of course a finding difficult to explain since it could be expected that cameras would have a stronger effect where they are located than in the immediate vicinity/entrances. Table 7.2 summarizes the attributes at the station most related to crime and disorder rates for the two data sources.

The list presented in Table 7.2 reflects the frequency that these variables come out statistically significant in the following models (higher at the top of the table): total crime, violence, theft, vandalism, robbery, burglary and other types of events at the station (Appendix, table 7.2 shows a selection of the results). There were several attempts to exclude variables that showed different signs for different types of offences. For instance, seating places or benches seemed to reduce robbery, but increase public disorder. The number of CCTV cameras also showed unexpected signs for two offence types. For violence and burglary in the SL database, findings show that having a visible CCTV camera at any part of the station is associated with greater crime rates. However, these results are not confirmed by the model using police data, where the variable for number of CCTV cameras shows the expected sign for violence but unexpected for burglary. One of the reasons for this mismatch is that cameras were installed in certain stations because they were *already* known to be *problematic* stations (and may not have been effective enough to deter burglary). Similar reasoning can be made about the existence of security mirrors as a supporting safety device at stations.

Variables reflecting the conditions at the stations explain around 30 percent of the variation of crime and disorder rates; this percentage varies by offence type and reaches its highest at 64 percent for vandalism when variables indicating neighborhood conditions and city context are added to the model. The addition of these variables generally improves the models, but not for all offences. Still some of the variables reflecting the conditions at the stations have a strong impact in step 3, for instance, the presence of hiding places/corners, good illumination/visibility and, to some extent, CCTV cameras. For total crime and disorder, the goodness of fit of the models is very similar for both the SL and police databases. However, the significant variables are different since the first dataset reflects only what happens at the station, while the second covers incidents within a buffer area from the stations. Guardianship and illumination explain 30 percent of the variation of crime rates from the SL database; it goes up to 52 percent when other neighborhood variables (number of police stations within 100 meters) and city context (distance to city center) are added to the model. The importance of formal control (police station nearby) has shown a strong effect on crime and disorder in previous research (Chaiken et al. 1974; Van Andel 1989), but, surprisingly, disappears in the model based on the police data.

The importance of surroundings

As much as 44 percent of all offences in Stockholm municipality takes place within 300 meters of a subway station, which are spread over approximately 25 percent of the municipality's land area (Figure 7.5)[15].

How much of the stations' surroundings explain variations of crime rates at the stations? For violence, the R-square adjusted value nearly doubles when surroundings variables are added to the model using the SL database. For violent rates and police data, despite a poorer goodness to fit, the model shows that more crime and disorder are found where there are more dark corners on platforms, more hiding places in transition areas, fewer CCTV cameras, transition areas with signs of deterioration, and poor surveillance in the lobby and exit areas. For robbery, the situation is reversed; the model based on police data performs much better than the one based on SL data. Surrounding variables such as open entrances, distance to city center, population density, and the presence of privately owned homes are all related to high rates of robberies in the police data.

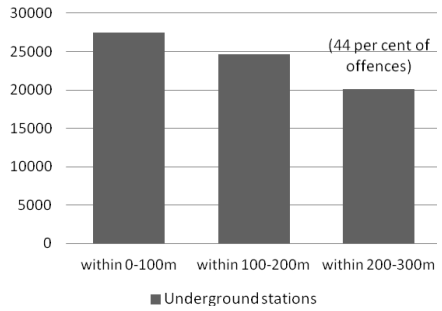


Figure 7.5 - Offences reported up to 300 meters from Stockholm's subway stations. Data source: Police data, 2008.

The model based on Stockholm Public Transport Company data shows that vandalism rates tend to be related to a lower number of exits (an indication of centrality but also the size of the station, this case large), lobbies with signs of physical deterioration (crime attracts crime), platforms covered by rain shield, poorly illuminated transition areas, and neighborhoods with people more moving out.

Surprisingly, some of the variables depicting the surrounding areas turn out to be non-significant or have an unexpected sign (net population). For example, no effect was found for schools in the surrounding area or for alcohol stores as suggested in previous literature (e.g. Block and Block 1995; Loukaitou-Sideris et al. 2002). However, this is not to say that surroundings are not important in explaining the variation of crime rates at the station. The variable of alcohol stores does not include restaurants and pubs, only state alcohol stores, which may explain the

[15]As a reference, as much as 95 percent of all offences in Stockholm municipality takes place within 300 meters of a bus stop. Bus stops plus 300 meters cover 66 percent of the municipality's area.

results. The presence of (ATM's) shows an increasing effect on violence (Table 7.3).

Table 7.3 - Station attributes, neighborhood surroundings, and city context as related to crime and disorder.

Variables associated with higher crime rates	Variables associated with lower crime rates
Few people at the station	Good illumination/Visibility
Corners, hiding places	CCTV cameras
Peripheral stations	Fewer ATMs nearby
Fewer police stations	Lower population density
Fewer residents moving out	Less presence of physical deterioration

The hypothesis 3 that stations located in inner city areas run a higher risk of all types of offences cannot be corroborated from this study's results. Theft and property crime rates tend to be higher in a couple inner city stations, but this pattern does not hold for other types of offences. Peripheral stations are more often targeted regardless of offence type or model type (the variable *distance to city center* proves to be statistically significant in most of the models), even after controlling for a number of other socio-demographic and economic characteristics of the surrounding areas of the stations.

End-stations such as Hjulsta, Farsta Strand, and Hagsätra show high rates regardless of crime type. Some of these peripheral stations are located in places that, although planned as part of the neighborhood, do not easily allow guardianship and natural surveillance from the outside. They are usually close to a large road or are, to some extent, cut off from surrounding land uses by forests or vacant land. They are also far from people's movements, which could potentially be the *eyes on the stations*, paraphrasing Jacobs (1961), who suggested that people witnessing what happens in the streets reduces crime opportunities.

However, results show that poor illumination, overcrowding, and littering were not important in explaining the variation of station crime and disorder rates in the winter (since the results were generally poorer compared with those for summer, they are not reported in Table 7.4). Often the snow, gravel, and dirt in public environments in the dark months of the year change the tolerance level for litter and garbage on the floor, which would not pass unnoticed in the summer. This may indicate that the threshold for what is good and poor illumination changes over time, affecting offenders' perceptions of opportunity and, consequently, the decision to commit a crime.

7.4 Concluding remarks

This chapter reports on the assessment of safety conditions in subway stations and surrounding areas where individual trips take place. Findings show that a relatively small share of reported events is *crim*e; acts of public disorder are more common at the stations. Although a highest *number* of events is found in the Central Station, the so-called 'end-stations' often show higher *rates* than those located in the inner city. These findings lend weight to principles of traditional urban criminology theory such as routine activity and social disorganization.

The environment at subway stations follows some common standards (e.g. illumination, gates, real-time arrival information, and platform/lobby structures), but they are not homogenous. Differences in the environments and their neighborhood contexts have an impact on the stations' vulnerability to crime and perceived safety.

Results also show that features indicating barriers to formal and informal social control are related to higher offence rates, such as few people in the station, objects obstructing visibility/surveillance, corners, and hiding places. Good illumination and less presence of physical and social disturbance are often related to lower rates of crime and social disorder events. The city context of these stations is also important to the stations' vulnerability. Stations are more often targeted by crime and disorder when they are located in more peripheral neighborhoods with higher housing instability (people moving out), higher population density, and fewer police stations.

Table 7.4 - Results of the Regression Analysis for Summer: Y= Log of offence rates at stations and surroundings.

	Database	R^2-adj	At Station	R2-adj	Station and Surroundings
Total Crime	Stockholm Public Transport Company	R^2 = 31.0%	Pcrow***(-), Tillu**(-)	R^2=51.9%	Pcrow***(-), Tillu***(-), CityD***(+), Cpolic***(-)
	Police	R^2 = 39.9%	Cctv***(-), Tvis***(+), Tcross***(+), Eesup***(-), Esocd**(-)	R^2=51.8%	CityD***(+), CExit**(+), Cctv***(-), Lseat**(-), Tvis**(+), Tcross***(+), Eesup**(-), Esocd**(-), Forg**(-),
Violence	Stockholm Public Transport Company	R^2=26.5%	Psecu*(+), Pnum*(+), Tnice***(-)	R^2=44.2%	Psecu**(+), Pnum***(+), Pcrow**(-), CAtm***(+) , Cctv***(+), CityD***(+), Forg**(-),
	Police	R^2=43.9%	Pcorn***(+), Ccctv**(-), Lvis**(+), Lillu**(+), Lsur***(-), Lseat*(-) Thid**(+), Tvis*(+), Tcross**(+), Tdetr**(+), Esur***(+),	R^2=35.6%	Pcorn***(+), Ccctv**(-), Lvis*(+), Lillu*(+), Lsur***(-), Thid***(+), Tdetr**(+), Esur***(+),
	Stockholm Public Transport Company	R^2=32.4%	Pundr***(-), Lsun***(+), Lseat***(-), Lundr*(+), Lsocd ***(+), Tlitt**(+)	R^2=20.5%	Pundr***(-), Lsun**(+), Lseat***(-)
Robbery	Police	R^2=36.0%	Tvis***(+), Thid**(+), Tesup**(+), Telvs***(+), Eopen**(+)	R^2=55.7%	Ploun**(-), Tvis***(+), Thid***(+), Tesup***(+), Telvs*(+), Tcross**(+), Eopen***(+), CityD***(+), PoPD*(+), Villa**(+)
Vandalism	Stockholm Public Transport Company	R^2=54.6%	CExit***(-), Proug*(+), Pcrow***(-), Tillu**(-), Tsur**(+)	R^2=64.0%	CExit***(-), Proug**(+), Pcove***(+), Ldetr**(+), CityD***(+),Tillu**(-), Pin-out**(-)
	Police	R^2=41.5%	Cctv***(-), Eesup***(-)	R^2=41.5%	Cctv***(-), Eesup***(-)

Pcrow = Generally crowded at platform; **Tillu** = Transition areas are well illuminated; **CityD** = Distance from city center; **CPolis** = Number of police stations within 100 meters; **Ccctv** = Number of CCTV cameras placed at station; **Tvis** = Visibility in transition area; **Tcross** = Cross-sections/junctions/disruptions in transition area; **Eesup** = Exits have escalator(s) **Esocd** = Presence of social disorder at exits; **CExit** = Number of exits; **Lseat** = Presence of seats/benches in lobby area; **Forg** = Percentage population with foreign background within 100 meters in 2007; **Psecu** = Platform has CCTV cameras placed and visible; **Pnum** = Number of platforms at station; **Tnice** = Transition area has nice/pleasant atmosphere; **CAtm** = Number of ATMs within 100meters; **Pcorn**= Presence of dark corners at platform; **Lvis**= Visibility in lobbies; **Lillu** = Lobbies are well illuminated; **Lsur** = Possibility of surveillance by others in lobby; **Thide**= Presence of hiding places in transition areas; **Tdetr** = Physical deterioration in transition areas; **Esur** = Possibility of surveillance by others at exits; **Pundr** = Platform located underground; **Lsun** = Sunlight easily illuminates lobby; **Lundr** = Lobbies located underground; **Lsocd** = Presence of social disorder in lobby; **Tlitt**= Presence of any litter in transition areas; **Tesup** = Transition area has escalator(s) **Telvs** = Elevator smells/a lot of graffiti in transition areas; **Eopen**= Exit layout is of open type without walls and roof; **Ploun** = Platform visibility towards lobby area; **PopD** = Population density within 100 meters; **Villa** = Privately owned houses; **Tsur** = Possibility of surveillance by others in transition areas; **Pcove** = Platform covered by (rain) shield; **Ldetr** = Physical deterioration in lobbies; **Pin-out** = Net population (difference between population moving in to and moving out from the area in 2007).

Chapter 8
Patterns of perceived safety in Stockholm's subway stations

There are a number of factors that affect perceived safety at transportation nodes. Some of them, as discussed in Chapter 5, are related to the characteristics of those who fear (e.g. gender, age, disability, previous victimization), while others are triggered by the environment (e.g. the station, the neighborhood, the type of transportation system[16]) or by other, less tangible aspects that affect individuals' anxieties (e.g. fears about terrorism and the future). Whether the environment or an individual's characteristics has more impact on perceived safety at the station is a difficult issue to assess and, data permitting, must be empirically tested. In the Stockholm case, there are relevant issues that are worth investigating using the available data. For instance, whether variations in perceived safety can be explained by individual groups; to investigate the importance of environment on stations' perceived safety; and whether perceived safety at the stations is affected by the city and neighborhood surroundings. These are some of the issues that are treated in this chapter. The analysis is based on the 2008 Stockholm Safety Survey[17] (with a sample of residents) and the 2011 Stockholm Public Transport Company Safety Survey (SL) of passengers[18].

Interviews with passengers and personnel conducted during the fieldwork phase are also informative in illustrating perceived safety at the stations. About a hundred individuals (half of them passengers) including personnel at the ticket booths, security guards/customer service hosts (*värdar* in Swedish, people walking around to help), and passengers were asked about their personal safety. Although this sample is not representative for each group, their answers provide examples of safety conditions at the stations at the time of the fieldwork. Patterns of perceived safety at subway stations and surrounding areas are discussed in the next sections. The chapter also reports on findings of hypothesis testing using Ordinary Least Squares (OLS) models.

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[16] More passengers are dissatisfied in general with commuter trains than they are with subways in Stockholm according to the 2011 Stockholm Public Transport safety survey (Stockholm Public Transport Safety Survey 2011).

[17] Selected questions: *1) Are you afraid of being a victim of crime at the subway station? 2) Are you afraid of being a victim of crime when walking home from the subway station or bus stop during the evening/night? and 3) Are you afraid of being a victim of crime in your own neighborhood?*

[18] Selected question: *When I travel by this route in the evening and/or at night, I feel safe when I travel alone (subway system only).*

8.1 Perceived safety at the stations

As much as 74 percent of passengers are satisfied with the quality of the public transportation services in Stockholm in an assessment that includes, for instance, frequency and punctuality of trains and buses, cleanliness of subway cars/buses and stations, and perceived safety (Stockholm Public Transport Safety Survey 2011). However, the proportion of satisfied individuals for *only* safety in the subway system is smaller: 53 percent for women and 72 for men.

However, these system-wide figures do not reflect the particular safety conditions at the stations. More interesting is to identify stations that are perceived as the most (un)safe. Islandstorget, Telefonplan, Slussen, Farsta, Gärdet, and Hagsätra are regarded as safe stations by those who answered the 2008 Stockholm Safety Survey. Why are these perceived as especially safe? They tend to be located in less criminogenic neighborhoods (but not always), characterized by small-scale building structures (but not necessarily detached houses), and are mainly residential with higher income owners and not too densely populated. They are located in areas offering convenient walking paths through the residential areas to the station; and such a landscape provides high visibility from dwellings towards public spaces. Some of these stations are embedded in the central residential areas of Stockholm. It is also common with fewer large or wide streets/roads to cross and easy, comfortable access to the station via well-lit entrances.

The stations that are perceived as less safe are often the more criminogenic (although this pattern may vary by crime type). Bivariate correlations are calculated using crime rates and proportions of survey respondents who feel unsafe. The percentage of those who answer *yes, I feel unsafe at the subway station* (*sometimes* to *often*) is significantly positively correlated with violence rates reported at the station. In general, subway stations with high crime rates (violence and theft) tend to be selected by those survey respondents who state that they feel unsafe (within the unsafe scale range *medium* to *high*) (Figures 8.1(a) and (b)). Stations such as Hjulsta (peripheral) and Fridhemsplan (central) show relatively high crime rates and are perceived as relatively unsafe stations.

There is also a correlation between the violence rates recorded at the stations and the percentage of those who feel unsafe when walking between home and the subway station or bus stop during the evening/night. This also applies to acts of social disorder and threats (Figures 8.2 (a) and (b)). Similar patterns are found for crime rates in the police data, but the relationship between crime rates and perceived safety is not as strong as those found in the SL data gathered at the station. Examples of subway stations most perceived as unsafe within 200 meters of the station are Hjulsta, Central Station (*T-Centralen*), Slussen, Skärholmen, Hässelby Gård, and Farsta Strand. The walk home during the evening/night from a subway station is perceived as highly unsafe at stations such as Hässelby Gård, Hjulsta, Farsta Strand, Central Station (*T-Centralen*), Globen, and Skärholmen. The Cen-

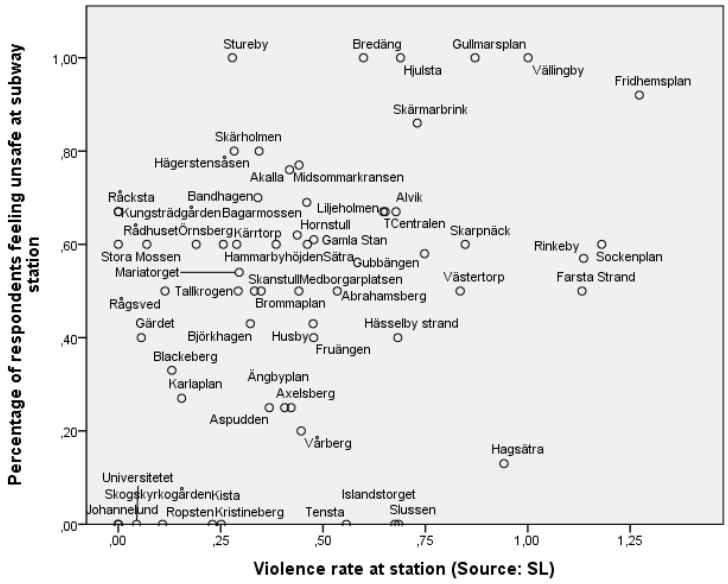
tral station and Globen are central but all other are located on the outskirts of the city.

However, the patterns of perceived safety do not always reflect the stations' crime rates. For instance, stations as Stadion, Tekniska Högskolan, and Universitetet have some of the lowest crime rates (regardless of crime type), but are perceived as unsafe subway stations. The fact that these stations have a central location and large flows of passengers affects both crime rates and perceived safety (central areas often tend to be associated with poor safety, with mixed land uses and high concentration of people during certain hours of the day). These stations are also the *underground-type*; they do now allow natural surveillance in the same way as ground-level stations that are open towards their surroundings. These two aspects could explain poor perceived safety. Moreover, both the stations Universitetet and Tekniska Högskolan are linked to university campuses, and Stadion with a sports stadium, with relatively low densities of residents within 200 meters of the stations.

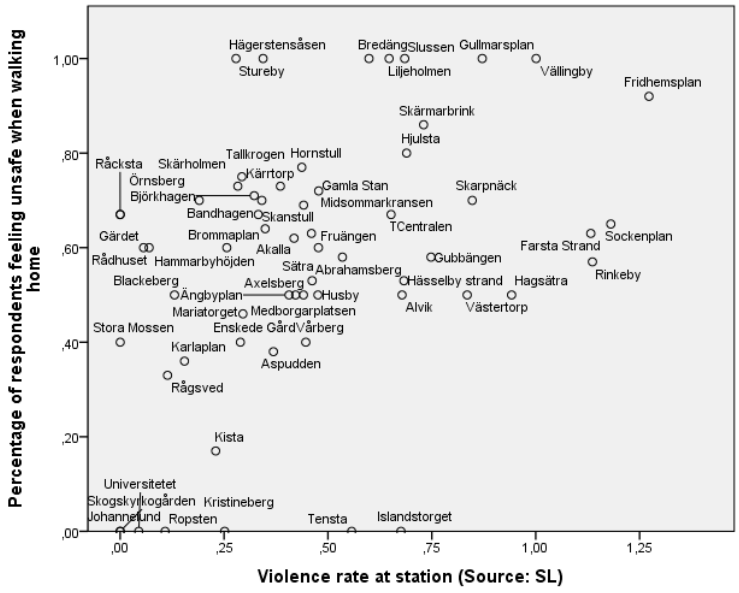
Stations with high crime rates are not always perceived as unsafe either. Examples of this mismatch between high criminogenic conditions and low perceived safety are found at peripheral stations such as Hagsätra, Rågsved, Rinkeby, and Aspudden, but also at inner city stations such as Medborgarplatsen. As a matter in fact, Hagsätra is considered to be one of the safest stations. One possible explanation for this is that despite being a place where people converge and many criminogenic events occur, stations can be perceived as *safe realms* where social control by personnel and passengers makes the place relatively safe, particularly in highly criminogenic neighborhoods.

Safety at stations by subway line

Perceived safety does not differ much between the three subway lines: Green, Red, and Blue. As much as 48 percent are dissatisfied with their safety on the Red line, while on the green line, the most unsafe by crime rate, the percentage is 51. The average perceived safety at the stations on each line was compared using data from the 2008 Stockholm Safety Survey. The respondents included both individuals that use public transportation everyday and those that rarely use it, but still have a perception of station safety. What is remarkable is that perceived safety ratings are significantly correlated with average crime rates regardless of data source (data recorded at the station or by the police), and follows a similar hierarchy: less safe on Green line than on Blue or Red within a radius of 100 meters from the station. As for feelings of safety when walking between home and the station during the evening/night, the relationship with crime rates within 100 meters of the station is neither strong nor statistically significant.

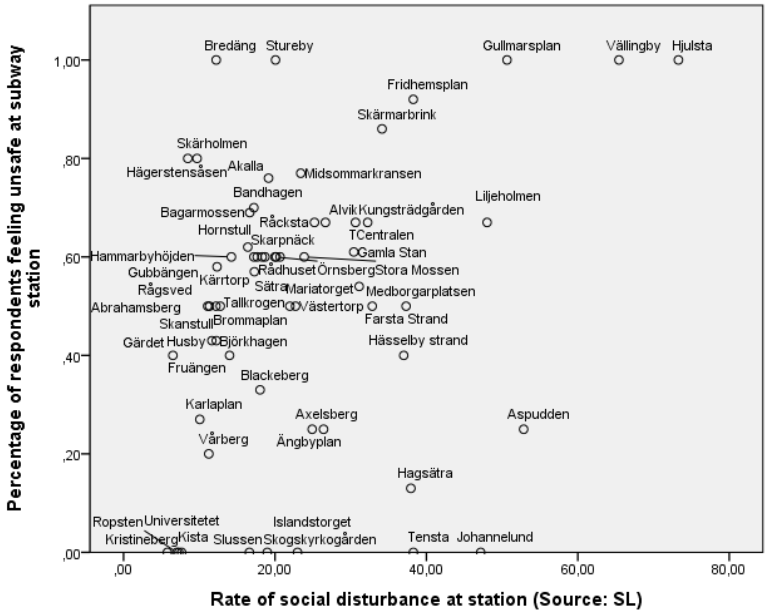


(a)

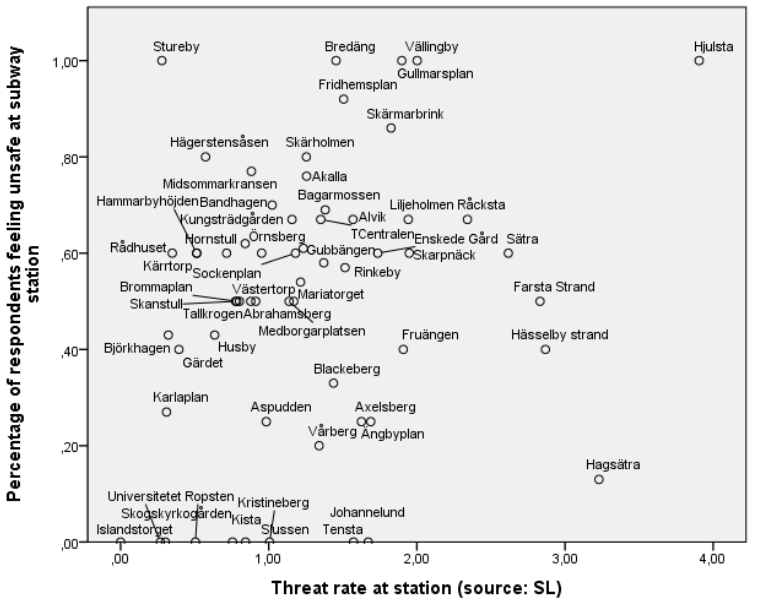


(b)

Figure 8.1 – Feeling unsafe at stations (a) and when walking home (b) in relation to violence rates at stations.



(a)



(b)

Figure 8.2 – Feeling unsafe at stations in relation to (a) social disorder and (b) threat rates at the stations.

When the assessment is done using a larger radius of 200 meters around the station, the Blue line is perceived as less safe than the Green (with 60 percent of respondents feeling unsafe). Again, the red line is perceived as the safest, with only 50 percent feeling unsafe.

When these percentages based on residents are compared with data from passengers' ratings of perceived safety collected at the stations (Stockholm Public Transport Safety Survey 2002- 2006), higher levels of satisfaction with safety are found (60 percent of the total). Passengers' perceived safety seems to be more stable on the Red and Green lines than on the Blue one, although the statistically significant difference of satisfied respondents in 2006 was on the Blue line. Retrospectively, it is difficult to point out exact reasons for shifts in perceived safety between lines. However, as always happens on subway lines, refurbishment and management work imposes restrictions and disruptions of service, which affects passenger perceptions. When disruptions occur, replacement buses are used, which modifies passengers' routines. Variations in the quality of the subway service (punctuality, frequency of trains) or with other means of transportation linked to the subway (e.g. subway-bus; subway-commuter train; subway-bicycle) can also indirectly affect the perceived safety of the entire trip. Differences in the demographics and socio-economic of the population surrounding the lines may also help explain these differences.

8.2 Perceived safety of the stations' surroundings

Subway stations are perceived as more dangerous than the neighborhoods in which they are located (57 percent felt unsafe at the stations and 45 per cent in the neighborhood) according to data from the 2008 Stockholm Safety Survey. However, as Table 8.1 shows, it is the walk to/from these transportation nodes that are feared the most (64 percent of respondents).

These findings are illustrative of at least three interesting issues:

1) This exemplifies how daily journeys encompass different environments that are populated by diverse groups of people and activities, which are, in turn, associated with different levels of risk.
2) Stations are perceived as more criminogenic than the overall neighborhood. This might be related to the fact that 60 percent of all crimes in Stockholm are committed within 500 meters of the subway stations; these *station plus 500 meters*-areas comprise 29 percent of Stockholm municipality's area (see Chapter 7).
3) These results also highlight the importance of adopting a *whole journey approach* (e.g. home - walk to station - at the station - on the subway - … - destination) when assessing perceived safety. Although most individuals feel safe on their doorstep, half of them feel that their safety decreases as they move away from their homes.

Why is the way to the station perceived as less safe than walking in the neighborhood? One could suggest that there is something special with this environment that is not found anywhere else in the neighborhood. In the case of Stockholm, some sections of the urban fabric link residential areas to transportation infrastructure: streets close to highways, isolated areas, forested or vacant land, in other words, places through which people move but that do not encourage natural surveillance (see e.g. Atkins 1989; Loukaitou-Sideris 2006; 2012).

Table 8.1 – Perceived safety of transportation nodes and of neighborhoods.

Places	Declared unsafe (% of respondents)
At the station	57 %
Walk to/from the station	64 %
Home and proximity	23 %
Neighborhood	45 %

These areas can also be corridors of mixed land use, with commercial areas or industrial buildings where people move around only during the day. In more central areas, they can be places where restaurants, bars, and places of entertainment attract people from other neighborhoods; so, although being residential, these inner city areas can feel unsafe on the way to/from the station because of the activities and people they attract (e.g. Bromley and Stacey 2012). The answers to these questions require a detailed survey of individuals' movement patterns in order to capture their locations and the types of environments they are exposed to along the whole trip. These environments from the front door to the station can potentially provide information about what leads to fear. Another approach is to assume that the environment alone does not explain differences in safety perceptions to/from the stations; rather it is the type of individual (and how they fear) that affects safety levels. For instance, in the 2008 Stockholm Safety Survey, those who perceived the subway stations (or the way to/from them) as unsafe tend also to feel that their overall neighborhood is unsafe. Both of these approaches are discussed in detail below, beginning with the general characteristics of the environments, followed by user groups.

Perceived safety and proximity to the station

Do people residing close to the station feel more unsafe? Multiple buffers are created around the stations in order to assess whether there is an effect of distance on perceived safety as one move away from the station. Findings show that stations are generally perceived as more criminogenic than the neighborhoods in which they are located. Overall, the closer one lives to a station, the more unsafe one tends to feel at the station, but the difference between them is not large. The analysis shows that more people feel unsafe the closer they live to the station (57 percent within 500 meters and 54 percent up to 2 kilometers, for instance) but sur-

prisingly, safety is not strongly affected by distance from the station (Table 8.2). Those living close to the station may be more exposed to the negative effects of these transportation nodes (e.g. crime, noise, busy commercial areas nearby) than those who live far away, but these disadvantages are balanced against advantages of living close to a station (e.g. quick access to a train or easy access to some other services). The ambiguous effects of transportation nodes on their immediate environments has been previously pointed out by, for instance, Ceccato and Wilhemsson (2011), that shows that close proximity to a subway station increases apartment prices in Stockholm, while living close to a commuter train station reduces them.

Table 8.2 – Respondents feeling unsafe inside and outside selected buffers (%).

	0-500 meters	500-700 meters	700m-1Km	1-2 Km	> 2Km
Unsafe at station	57%	57%	57%	54%	55%
Unsafe walking from/to station	65%	65%	66%	59%	60%

Is perceived safety at transportation nodes and their surroundings a reflection of the neighborhood's criminogenic levels? Although not tested statistically, there appears to be a relationship between unsafe subway stations, unsafe surrounding areas, and criminogenic neighborhoods, at least among the top ten stations by crime rates. Stations perceived as more unsafe are located in criminogenic neighborhoods. At stations such as Skarpnäck and Gullmarsplan (on the Blue line), both the walk to/from the station and the neighborhood are perceived as unsafe.

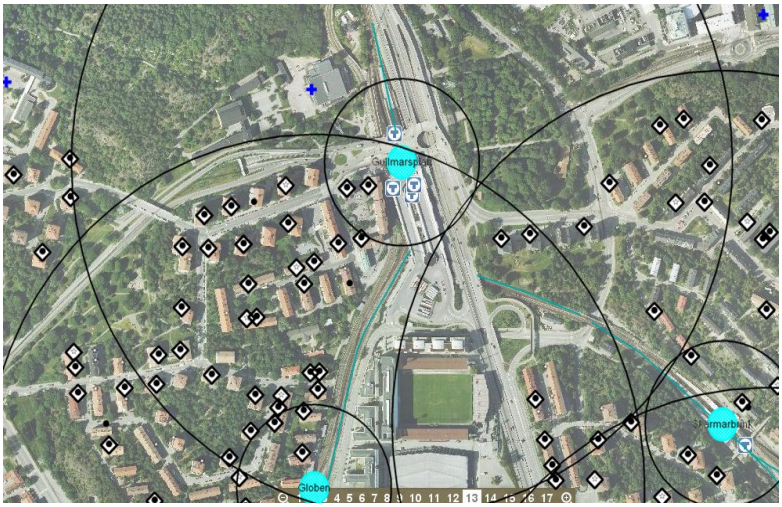
The way to Stockholm's central station is perceived as unsafe, which certainly reflects the relatively high crime rates at that core area of the city (Wikström 1991; Ceccato et al. 2002; Uittenbogaard and Ceccato 2012b). Skärholmen, Vällingby, and Högdalen stations show evidence that the walk to/from the station is often perceived as unsafe in neighborhoods with high crime rates. However, what is unknown is whether this pattern holds for all stations. Hjulsta, Vällingby, Gullmarsplan, Stureby, and Bredäng stations have a high percentage of people who feel unsafe both at the subway station and when walking home to/from them in the evening/night. Of these, Hjulsta has the third highest crime rate according to the SL data collected at the station and ranks high for vandalism and public disorder rates. Vällingby station has also one of the highest rates of public disorder and ranks among the top ten stations with high violence rates.

Is it possible to identify a pattern among these stations; in other words, is there a topology for safety? Stations do share a number of commonalities, but it is unclear whether these common characteristics are the factors underlying poor safety. (This issue will be further analyzed in Section 8.3.) In general, stations that are perceived as unsafe (e.g. Hjulsta, Vällingby, Bredäng, Gullmarsplan, Farsta Strand, Slussen) often are:

(1) either stations located in more problematic neighborhoods where the station is surrounded by highways and main roads;
(2) or in neighborhoods with a large share of mixed land use (where the stations is a central point), and often embedded in large transportation or hubs. These stations often are surrounded by high-rise residential buildings and few open spaces to provide sightlines and visibility. These stations often have tunnels as entrances, which may be rather dark and perceived as unpleasant during the dark months of the year, particularly in the evenings.

In order to illustrate these types of unsafe stations, two cases are taken as examples: Hjulsta and Gullmarsplan. Hjulsta station is surrounded by relatively high buildings built in the 1960s as part of the Swedish *Million Program* (the goal of which was to build one million new residences). Residents do not have to walk more than 500 meters to the subway, but some need to pass between tall buildings along small, semi-private lanes with few to no lines of sight outwards (and potentially poor social control). A large share of the population living in Hjulsta is composed of foreign-born individuals – a group that often tends to feel less safe than native Swedes according to the Stockholm Safety Survey (2008).

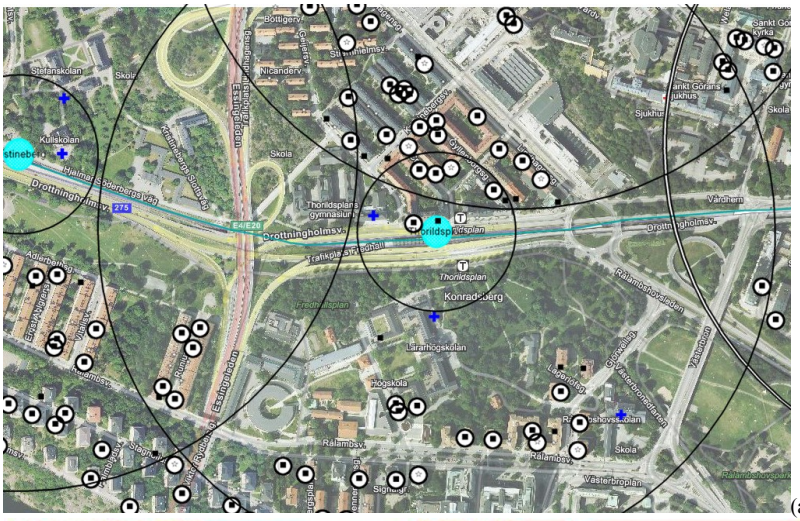
Gullmarsplan station is located more centrally, at a point of convergence, and it functions as a transfer hub for passengers using trains, buses, and the subway in an inner city area (Figure 8.3). The station is embedded in an environment with large roads and other transportation infrastructure. For instance, running just next to it is a main highway leading in and out of Stockholm city. To the north and east, the station is surrounded by large parks and greenery, and, understandably, the way to the station can be perceived as unsafe during the late hours of the day if illumination is not in place or faulty. Moreover, the entrances leading to the subway station include tunnels under the highway. Gullmarsplan also attracts many passengers traveling to/from the city's most important sports and entertainment arena (Globen, to the south of the station) during certain times. Despite many people on the streets, the area may lack capable guardians.



(a)

(b)

Figure 8.3 – Gullmarsplan station – an area of passenger convergence that is perceived as unsafe.
(a) Black dots indicate respondents who *perceive the subway station as unsafe*, and black squares respondents who *perceive the walk to/from the station as unsafe*.
(b) The station entrance is visible on the left, along the busy road. (picture source: eniro.se).



(a)

(b)

Figure 8.4 – Thorildsplan station – perceived as one of the safest.
(a) Black squares indicate respondents who feel safe at the stations, and black circles indicate respondents that feel safe walking to/from the station.
(b) Street view of Creutzgatan, leading to Thorildsplan subway station (picture source: eniro.se).

Thorildsplan, Islandstorg, Telefonplan, Vårberg, Aspudden, and Hötorget are examples of safe stations. Although Thorildsplan subway station is embedded in highly trafficked roads, users seem to appreciate its appearance and do feel safe there. Thorildsplan is perceived as safe by from both the perspective of the station and of the walk to/from the station. This station does show low violence rates and low public disorder rates, which may affect the overall safe feeling. The neighborhood is close to the city center with a large share of residents owning their homes.

(a)

(b)

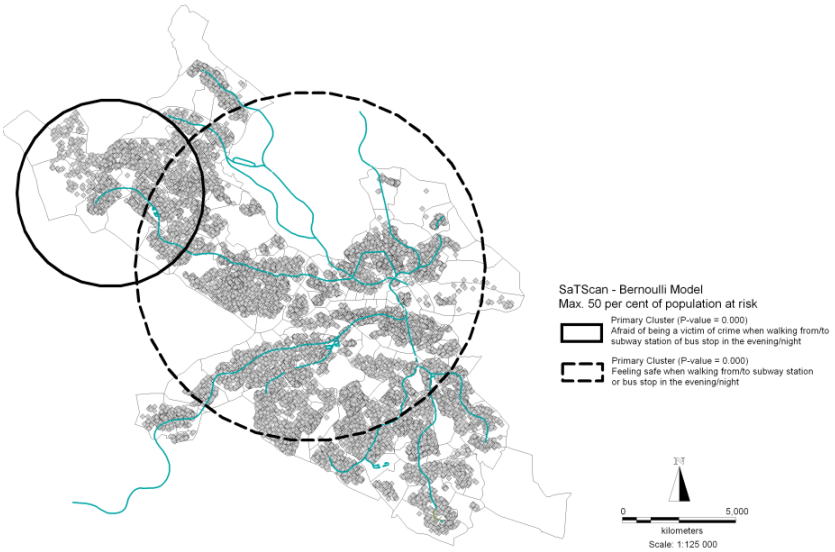


Figure 8.5 – Clusters of subway stations and surrounding areas perceived as (un)safe.
(a) Afraid of being a victim of crime at the station.
(b) Afraid of being a victim of crime on the way to/from the station.
Source: Ceccato et al. (2011a:53).

Thorildsplan is not the only station that is both central and perceived as safe. According to the respondents of the Stockholm Safety Survey (2008), the stations located centrally are significantly safer *as a group* than those located elsewhere. In Figures 8.5(a) and (b), the primary clusters (dashed lines) represent respondents that *feel safe at the subway station* and that 'feel safe while walking home from the station during the night', respectively. These clusters are statistically significant and include the central area of Stockholm municipality, including the inner city areas and the more affluent areas to the north (Enskede) and east (Bromma). The individuals who answered *yes, I feel unsafe* were used as a case, while those who answered *no, I feel safe* were used as a control in order to detect clusters of those that, for instance, feel unsafe at subway stations. The hypothesis of spatial clustering was tested using Kulldorff's method (see Chapter 6 for detailed descriptions of this clustering method).

An unsafe cluster for each perceived safety question was found in different geographic areas in Stockholm (solid lines). The cluster identifying respondents that *feel unsafe at the subway station* is located to the southwest (e.g. in Skärholmen, Sätra, Fruängen, Västertorp, up to Aspudden) (Figure 8.5(a)). The cluster of those who *perceive the walk home from the subway station during the evening/night* as unsafe is located in the northwest part of Stockholm, including the subway stations of Hässelby Strand, Hässelby Gård, Vällingby, Johannelund, down to Åkeshov (Figure 8.5(b)).

Safety at subway stations varies both in space and in magnitude. For instance, while the cluster of individuals that *sometimes feel unsafe* at the subway station has its core in the southwest part of Stockholm (stations of Skärholmen, Sätra, Fruängen, Västertorp, up to Aspudden), the cluster of individuals who *often feel very unsafe* at the subway station is concentrated in the northwest part of Stockholm, including subway stations such as Hjulsta, Rinkeby, Kista, Akalla, Tensta, and Husby.

Perceived safety by user group

Half of those who work at the station have witnessed different forms of threats, events of public disorder, and/or violence/fights. This may explain why personnel at the station tend to be more pessimistic about safety conditions, particular those at the ticket booths/gates.

> I was attacked once, in that dark corner near the elevator (A cleaner on duty at Bagarmossen station).

Customer service hosts have a comprehensive picture of what happens at the station as they move across the subway network and work closely with ticket collectors, drivers, and traffic management. They indicate that platforms, gates, as

well as lobbies tend to be the most targeted places at the stations, perhaps because most of them work in these areas.

Most of the passengers interviewed during the fieldwork said they feel safe at the station, but those who felt unsafe (one-fifth of those interviewed) are the ones that had been victims or had witnessed fights, robbery, or other safety problems:

> My friend was robbed once at a subway station (A passenger in his 20s at Duvbo station).
> I often see fights on the platform during the evening from my window *(*A passenger in his 20s at Skärmarbrink station).
> Sometimes I see people peeing here in the corner (A passenger in his 20s at Sunbyberg station referring to urination on the platform).
> It is a pity they sprayed the whole floor… (A passenger in her 40s at Björkhagen station where graffiti was extensively applied to the floor).

When exploring the effects of demographics, one often looks at factors such as differences in perception by age and gender. As expected, lack of declared safety tends to be more often associated with older groups of the population. This is also the case also for Stockholm. The 2008 Stockholm Safety Survey shows evidence that adult residents (26-65 years old) feel less safe at subway stations than the young and the elderly groups ($\chi^2 = 76.8$, df = 2, p = 0.000).

Perceived safety is also gendered. Women have a tendency to feel more fearful at the station, on the way to the station, as well as in the neighborhood; the Chi-square value is significant at p = 0.000 for all categories. Note that as many as 72 percent of women feel unsafe at subway stations (compared to 54 percent of men), although the percentage is even higher for women on the way home from subway stations (85 percent for females and 56 percent for males). A similar pattern is also found in the 2011 Stockholm Public Transport Safety Survey, but in this poll, higher levels of satisfaction were found at the station. Men feel safer than women when travelling alone or going to/from the station during the evening/night. There is also a clear difference between men and women regarding perceived safety on the various public transportation modes. For women, 53 percent feel safe when they travel alone on the subway in the evening/night; the corresponding figure for men is 72 percent.

Individuals with a foreign background (born abroad) perceive their neighborhood as significantly less safe than native Swedish residents do ($\chi^2 = 36.8$, df = 1, p = 0.000); as well as the walk home to/from these during night ($\chi^2 = 5{,}0$, df = 1, p = 0.025) and the subway stations too ($\chi^2 = 6{,}3$, df = 1, p = 0.012). Having children influences safety perceptions as well. People with children are more worried at subway stations ($\chi^2 = 52.1$, df = 1, p = 0.000) and when walking home from them during the night ($\chi^2 = 39.4$, df = 1, p = 0.000) than people with no children. As much as 68 percent of interviewed individuals with children feel unsafe at stations, compared to 57% for individuals without any children. These numbers are even higher when considering the walk home from the station at night; 74 and 66 percent, respectively. There is no significant difference between the two groups when it comes to perceived neighborhood safety.

The type of tenancy (owner or renter) does not significantly impact perceived safety at subway stations. However, the walk to/from these stations is perceived as more unsafe by renters (χ^2 =32.1, df = 1, p = 0.000) than by owners. The same pattern is found for the perception of safety in the neighborhood's statistical test results. If one owns the property, this affects the way one perceives the neighborhood. The statistics show that 50 per cent of those who rent their dwellings do not feel safe in their neighborhood while this is only 44 per cent for house owners (χ^2 =72,2, df = 1, p = 0.000).

Perceived safety at the station varies geographically by group. Using data from the Stockholm Safety Survey (2008), an explorative cluster analysis is performed using four selected groups who feel more unsafe (responses from *sometimes* to *often*) than the average population: foreign-born persons, women, the elderly, and youth (Figure 8.6). The primary cluster for stations where foreign-born persons feel unsafe is located in the northwest part of Stockholm (solid gray line). When only women are selected, the primary cluster appears in the same area (solid black line). As previously suggested in Chapter 7, stations located in these areas (e.g. Hässelby Strand, Hässelby Gård, Vällingby, Johannelund, down to Åkeshov) impose challenges for crime prevention.

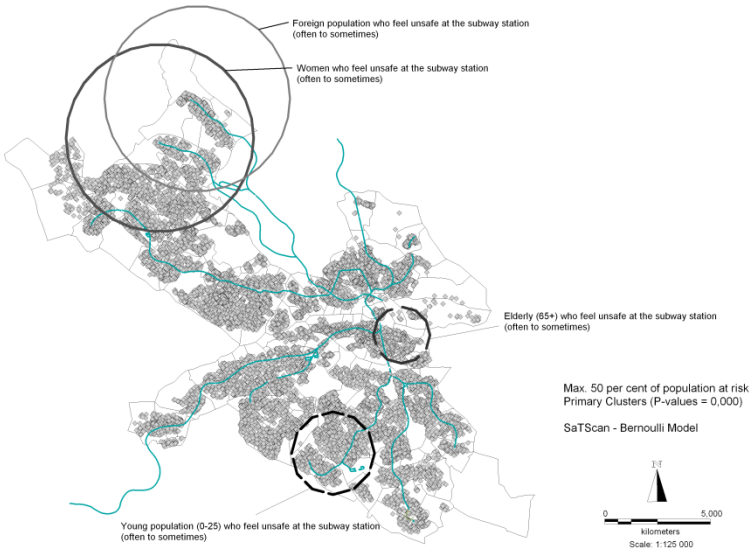


Figure 8.6 – Clusters of subway stations perceived as unsafe by selected groups of respondents: women, foreign-born, youth, and elderly.

For the elderly (65+), the significant cluster of unsafe stations is found in the city center (dashed gray line); more precisely in the Södermalm area, including the subway stations Slussen, Medborgarplatsen, and Skanstull. For the group *children and youth* (15-25 years old), the cluster is located in the south (dashed black line), including the stations Hagsätra, Rågsved, Högdalen, and Stureby. Both of these clusters tend to be overrepresented among those stations with relatively high vio-

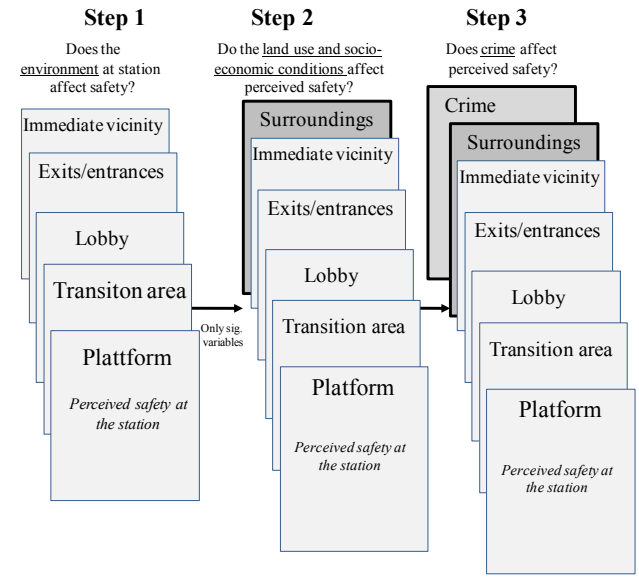
lence rates and acts of public disorder. Although the average local population considers Hagsätra safe (Figure 8.1), the young people who live in the area perceive it as unsafe.

8.3 Modeling perceived safety at the stations and surrounding areas

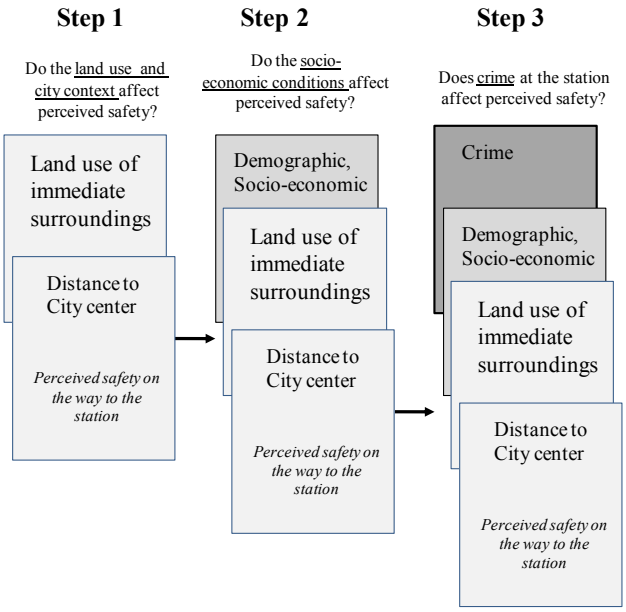
Perceived safety at the station is expected to be related to the environmental conditions at the station itself (physical and social environments, including crime) but also to its surroundings, such as the land use and socio-economic and city contexts. Individual characteristics (e.g. age, gender, household composition) are also expected to affect fear of being a victim of crime at transportation nodes and on the way to them. The elderly, women, and the disabled are often pointed out as more fearful than other groups of passengers (the effects of age and gender on safety are assessed here through the demographics of the areas; data on disability was not included). To check to what extent the criminogenic conditions at the station affect perceived safety, overall crime rates and each crime rates individually were added into an OLS regression model and the results are presented in Table 8.3. The dependent variables are perceived safety at the station and on the way to/from the station.

Figure 8.7 illustrates the two strategies adopted in the modeling process. The detailed rationale linking these underlying factors to perceived safety is laid out in Chapter 5. Some of the most important hypotheses are presented as a reference for the discussion of the results that follows:

H 8.1 – Criminogenic conditions at the stations, surrounding areas and in the neighborhoods affect perceived safety at the station and on the way (from/to) them.
H 8.2 - Environmental attributes of the stations affect (directly and indirectly) perceived safety at the stations. For instance, dark tunnels at station entrances should negatively affect perceived safety at the stations.
H 8.3 – Formal and informal social control (e.g. presence of guards, passengers) are expected to affect the fear of being victimized by crime at stations.
H 8.4 – The perceived safety at the stations or on the way to them depends on individual characteristics.



(a)



(b)

Figure 8.7 – Modeling strategy: (a) *Are you afraid of being a victim of crime at the subway station*? and (b) *Are you afraid of being a victim of crime when walking home from the subway station or bus stop during the evening/night?*

Perceived safety at the subway station

Around half of the variation in perceived safety at the stations (Figure 8.7 (a)) is explained by their environmental conditions, both the physical environment and social interactions that take place there, including crime and the conditions in the surrounding areas (socio-economic and land use variables) (steps 1-3). As much as 24 percent of the variation can be explained by environmental attributes of the stations only, while the other half is picked up by land use and socio-economic variables. After all variables are added to the model, only a small share of the variation of perceived safety at the station was left to be explained by crime rates. (Alone, crime rates explain 19 percent of the variation in perceived safety at the subway station.)

Unsafe stations are associated with visible social disturbance in lobbies, low surveillance, and higher rates of violence and events of public disorder. These stations are often located in neighborhoods with more social problems and high housing mobility (people move in and out). Previous studies in Los Angeles and in the U.K. also found evidence linking physical incivilities, crime, and fear of crime (e.g. U.K.Department of the Environment, Transport and the Regions 1996; Loukaitou-Sideris 2012).

Safe stations are related to station size (fewer platforms and exits), and, as previously hypothesized, with effective formal social control either though CCTV cameras or the presence of guards (on the platform). They are not central stations, but have a high potential for natural surveillance. The variables that were significant in all models were social disturbance, CCTV cameras, and housing mobility (Table 8.3). The role of social control has long been pointed out as a crime deterrent, but also for improving safety conditions. Multiple actors can perform social control: *handlers* who control potential offenders, *managers* who control places, and *guardians* who control the targets (Felson 2006). In the safe stations, the work of these local agents, including other passengers, effectively increases safety conditions.

Table 8.3 - Attributes of the stations and surroundings related to patterns of perceived safety at the station.

Variables associated with unsafe stations	Variables associated with safe stations
Visible social disturbance	High potential for natural surveillance
Low potential for surveillance (lobbies)	More CCTV cameras
Neighborhoods with social problems	Fewer platforms/exits
High housing mobility	Presence of guards
Fights, threats, social disorder, other	

Although crime is important in explaining unsafe stations in four out of six final models from step 3, property crimes, such as theft, do not play any role in ex-

plaining perceived safety. Stations with visible public disturbance and violence are the ones that are perceived as the most unsafe. The model including social disorder performs the best.

Table 8.4 - Regression Analysis: Y= Unsafe at subway station (proportion of those who answered the survey)[1].

	(a) All crimes	(b) Threat	(c) Fight	(d) Social disturbance	(e) Theft	(f) Vandalism
Coefficients of environmental variables						
PGuar	-.175	-.175*	-.182*	-.207*	-.191*	-.187*
PNum	.035	.114**	.132**	.077	.144**	.140**
LSur	-.11***	.044	.032	.027	.027	.031
LDist	.519**	.591**	.504**	.467**	.492**	.503**
EIllu	-.153	-.141	-.166	-.088	-.144	-.143
Coefficients of land use and socio-economic variables						
Forg	.002	.002	.002	.003	.002	.002
AVInc	-.000001	-.000001	-000001	-.000001**	-.000001	-.000001
PopD	.0000009	.000001	.0000008	-.000001	-.0000006	-.0000002
Pin-out	-.034***	-.032***	-.033***	-.028**	-.035***	-.035***
Villa	.002	.003	.002	.002	.002	.002
CAtm	.006	-.006	-.003	-.012	.012	.012
CityD	-.037	-.048**	-.038*	-.045**	-.027	-.029
CExits	.027	.031	.032	.043*	.027	.027
Sysb	.100	.106	.122	.133	.115	.119
Cpolis	.019	.032	.045	-.063	-.029	-.026
Skol	.057	.065	.062	.079	.059	.057
Ccctv	-.005*	-.006**	-.006**	-.006***	-.005*	-.005*
Coefficients of crime variables						
All crimes	.006	-	-	-	-	-
Threat	-	.121***	-	-	-	-
Fight	-	-	.034**	-	-	-
Social Dist.	-	-	-	.007***	-	-
Theft	-	-	-	-	-.039	-
Vandalism	-	-	-	-	-	.001
R-square	.424	.471	.443	. 487	.404	.403

Note = * significant at 10%, ** significant at 5%, ***significant at 1% and lower. [1]Are you afraid of being a victim of crime at the subway station?
PGuar= Presence of security guards at platforms; PNum= Number of platforms; LSur= Possibility of surveillance by others in lounge area; LDist= Presence of disturbance in lounge area; EIllu= Entrances/Exits are well illuminated; Forg= Percentage of population with foreign background in 2007 within 100 m; AVInc= Average income of working population in 2007 within 100 m; PopD= Population density within 100 m; Pin-out= Net population within 100 m (difference between population moving and moving out from the area in 2007); Villa= percentage of villa housing within 100 m (owned housing); CAtm= Number of ATMs within 100 m; CityD= Distance from city centre; CExits= Number of exits of station; Sysb= Number of state alcohol selling shops within 100 m; Cpolis= Number of police stations within 100 m; Skol= Number of schools within 100 m; Ccctv= Number of CCTVs placed at station.

Table 8.5 - Regression Analysis: Y= Unsafe on the way to/from the subway station (proportion of those who answered the survey)[2].

	(a) All types of crime	(b) Threat	(c) Fight	(d) Social disturbance	(e) Theft	(f) Vandalism
Coefficients of land use variables						
CAtm	.039	.034	.032	.031	.042	.043
CityD	-.021	-.022	-.022	-.020	-.013	-.013
CExits	.030	.031	.033*	.032	.029	.028
Sysb	.060	.062	.074	.066	.067	.070
Cpolis	-.016	-.018	.017	-.053	-.053	-.050
Skol	.000	.004	.006	.006	-.001	-.002
Ccctv	.005**	.004**	.004*	.004*	.005**	.005**
Coefficients demographic and socio-economic variables						
Forg	-.007**	-.007**	-.007**	-.007**	-.007**	-.007
AVInc	-.000003***	-.000003***	-.000003***	-.000003***	-.000003***	-.000003***
PopD	-.000006	-.000005	-.000005	-.000006	-.000007	-.000007
Pin-out	-.037***	-.037***	-.037***	-.036***	-.038***	-.038***
Villa	.004**	.004**	.004**	.004**	.004**	.004**
Coefficients of crime variables						
All Crimes	.004	-	-	-	-	-
Threat	-	.050	-	-	-	-
Fight	-	-	.028*	-	-	-
Social Dist.	-	-	-	.003	-	-
Theft	-	-	-	-	-.093	-
Vandalism	-	-	-	-	-	-.001
R-square	.390	.394	.412	.399	. 386	.378

Note = * significant at 10%, ** significant at 5%, ***significant at 1% and lower. [2] Are you afraid of being a victim of crime when walking home from the subway station or bus stop during the evening/night?

Perceived safety on the way to the subway station

The environment on the way to the station is expected to be associated with the land use and socio-economic characteristics of the surrounding areas but also the crime that happens at the station (Tables 8.4 and 8.6). Crime rates only explain 20 percent of the variation in perceived safety on the way to the station, followed by socio-economic and land use variables (15 and 11 percent, respectively).

Table 8.6 - Attributes of the stations and surroundings related to patterns of perceived safety on the way to/from the station.

Variables associated with unsafe stations	Variables associated with safe stations
Areas with social problems/ low percentage of foreign born population	Smaller stations (fewer exits/fewer CCTV cameras)
Detached houses	Low housing mobility
Fights	High population density

Perceived unsafety on the way to/from the station is often associated with living in areas with social problems (although not necessarily with predominately foreign-born residents) and often having some share of detached houses among other the housing types. Fights are often recorded at the stations and seem to impact perceived safety to/from the station. The stations tend to be smaller, with fewer exits and less presence of formal social control (e.g. CCTV cameras).

Although these models explain about 40 percent of the variation in perceived safety of the environments on the way to/from the station, the results do not provide clear clues about the types of environments they are. For example, some of the variables show an unexpected sign from what was expected or findings show indications that some of the variables are surrogates for others that are not present in the model, which makes any reasonable interpretation of the results a difficult task. One possible reason for this problem is a mismatch between the scale of the perceived safety variable and the scale captured by the covariates (explanatory variables). For instance, perceived safety on the way to the station is *a blurred measure of safety* over a not well defined geographical area, while crime rate is a centered variable based on station data. In the way the survey captures perceived safety, without a fixed geographical track of movement (from home to the station), it is difficult to know the environments that are causing fear. These limitations demand caution when drawing conclusions about the modeling results of perceived safety on the way to/from the subway station. A better measurement of safety should be based on the possibility to track locations between homes and stations over time. This could be combined with crime rates over the whole neighborhood (beyond the station's immediate surroundings).

8.4 Concluding remarks

Individuals tend to feel safer in their neighborhoods than at the subway stations. However, the stations are perceived as safer than the environments the individuals are exposed to on the way to/from the stations. These findings highlight the importance of adopting a *whole journey approach* when assessing perceived safety.

The patterns of perceived safety at subway stations are dependent on the physical, demographic, socio-economic, and criminogenic conditions of the transportation node and the surrounding areas, including the neighborhood context. Although stations that are perceived as unsafe tend to be more criminogenic, high crime rates alone do not explain patterns of perceived safety. Modeling results show, for instance, that perceived safety at the *unsafe stations* is associated visible social disturbance in lobbies, low surveillance, and higher rates of violence and events of public disorder. These stations are often located neighborhoods with more social problems and high housing mobility. (Some of these social factors are also behind low ratings of perceived safety on the way from/to the station.) On the other hand, *safe stations* are associated with fewer platforms and exits, but also, as previously hypothesized, with effective formal social control either though CCTV cameras or the presence of guards.

Perceived safety varies by group as well as geographically. While clusters of perceived unsafety at transportation nodes are concentrated in the periphery of Stockholm for some groups ((women individuals born abroad (Northwest parts of the municipality) and young people (in the South)), for the elderly, the stations perceived as unsafe is central. Those who feel unsafe at subway stations are generally women, adults, individuals with children in the household, and respondents born abroad. Although expected, these findings provide indications that safety interventions at transportation nodes may fail if differences in people's perceptions are not regarded as indications of differences in safety needs.

Chapter 9
The rhythms of crime at Stockholm's subway stations

The daily life of a city provides the targets for crime and removes them. The sleeping, walking, working, and eating patterns of offenders affect the metabolism of crime....We must study these rhythms of life if we wish to understand crime (Felson 2006:6-7)

In this chapter temporal patterns of crime and perceived safety are discussed both in relation to the overall city and to transportation nodes. As an illustration, the analysis draws upon examples from both Stockholm and elsewhere. It is intended to show how stations can work as an indicator of the city's daily space-time dynamics.

9.1 Crime variations over time

Crime opportunities are neither uniformly nor randomly organized in space and time (Ratcliffe 2010:5), but, as shown in chapter 5, they do follow rhythmic patterns of human activities.

Figure 9.1 shows the frequency of pickpocketing by time of day in Copenhagen, Denmark. Note in the maps the variation of the clusters over the day, a result from Kulldorff's scan test, standardized by daytime and nighttime populations. The first slice is selected because 7:00–8:00 am is one of the lowest frequencies of pickpocketing, while the second slice refers to one of the peak hours for this offense, between 2:00 and 3:00 in the afternoon. More interestingly, the two peaks of pickpocketing happen in the same general area but not in exactly the same place. In the map, the hot spot in the afternoon spreads across the city center and shrinks afterwards towards the morning hours.

Crime variations over time can be relevant when comparing crime profiles across city types in different political and economic contexts. For robbery, for example, very similar patterns emerge when comparing crime trends over the day in Tallinn, Estonia, Cologne, Germany and Stockholm, Sweden (Figure 9.2). The frequency of robberies is lowest during morning hours (circa 6:00–10:00 am) and then increases steadily throughout the day and evening, particularly in Cologne and Tallinn. In Cologne, there is a marked peak of cases around 6 pm, at the same time that shops close and people travel home from work. In Tallinn, robberies peak much later at night, suggesting a possible relationship with leisure and entertainment activities. The common feature in both cities is that robberies happen much more often during evening and night hours than during the day. The increase of robberies during night hours seems slightly more pronounced in Tallinn, and, in

all three cases, follows the curves of other violent crimes, see for example, the case in Stockholm in Figure 9.2.

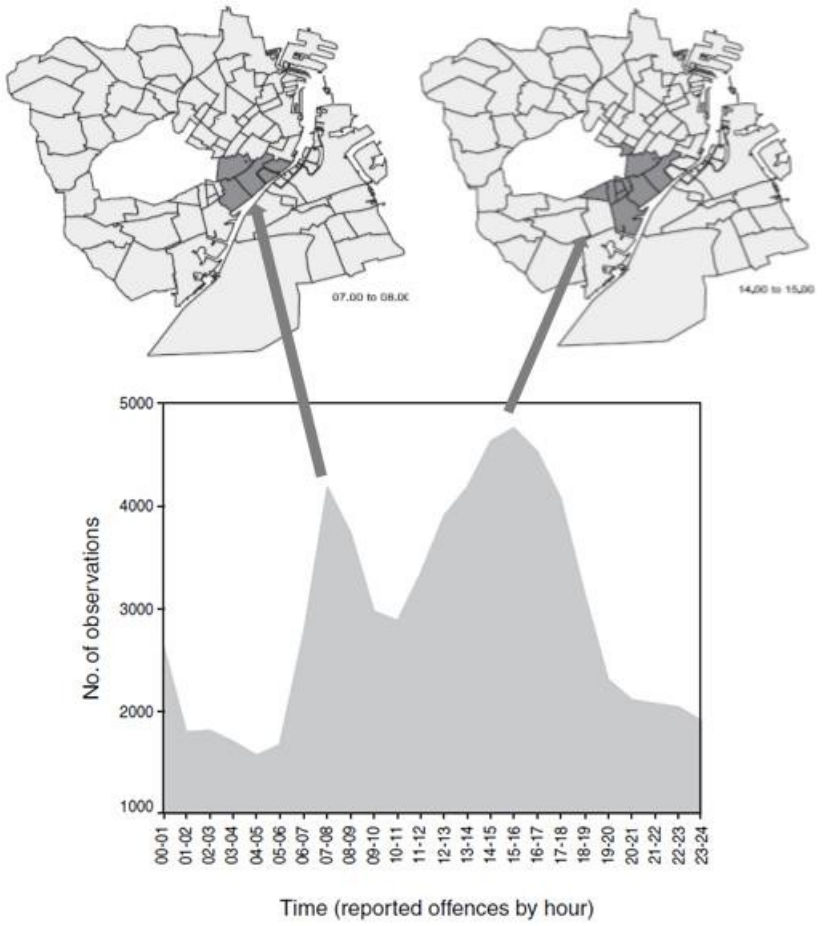


Figure 9.1 Pickpocketing events by hour: Copenhagen (Denmark) and, in the map, clusters standardized by nighttime and daytime populations.
Source: Ceccato (2005:278).

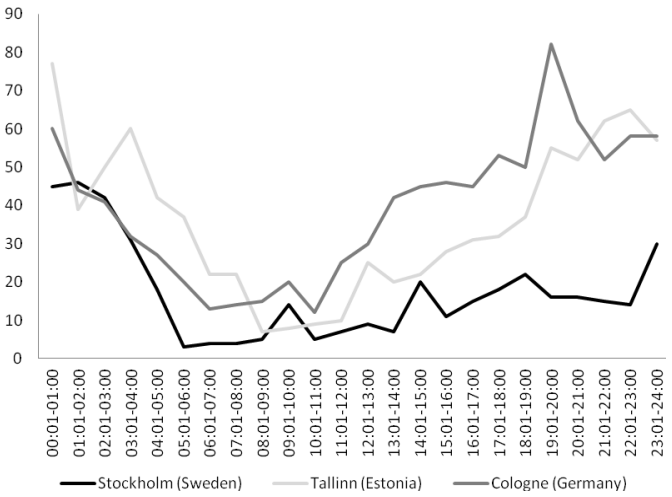


Figure 9.2 Robbery events by hour: Stockholm 2008 (Sweden), Cologne 1999-2000 (Germany), and Tallinn 2004-2005 (Estonia).

Monthly and seasonal variations in crime have long been documented in the international literature. Violent crime and domestic violence increase during summer months (Field 1992; Farrell and Pease 1994), while commercial robberies can increase during the winter (van Koppen and De Keijser 1999). The truth is that the international literature has often been contradictory since the time scales of the studies differ widely, as do their methodologies (for a comprehensive review, see Cohn 1990; Cohn and Rotton 2000). The relationship between homicide and heat based in current studies are, for instance, inconclusive since they show different results (Cohn 1990; Cohn and Rotton 2000; Hakko 2000; Rotton et al. 2004).

According to evidence from Cheatwood (1988) and Yan (2000), there seems to be no particular season for homicides. Michael and Zumpe (1983) show no clear links between temperature and monthly number of homicides in different geographic locations, and neither do Maes et al. (1993) in assessing the effects of weather variables on homicide levels. However, using cross-sectional and time series analyses, Rotton and Cohn (2003) show that temperature is associated with many violent crimes, such as assault or rape, but the effect of temperature was not verified for cases of homicide. In one of the few examples of cities in the global south, São Paulo, Brazil, Ceccato (2005) evaluates the influence of weather and temporal variations on violent behavior, such as homicide. The findings suggest that deprived central and peripheral areas show the highest numbers of killings over the year. Moreover, homicides take place when most people have time off: particularly during vacations (hot months of the year), evenings, and weekends. Overall, the results show that temporal variables are far more powerful than weather covariates in explaining levels of homicide for the Brazilian case, sup-

porting the suggested hypotheses in that study derived from routine activity theory.

Stockholm's clusters of violence tend to happen around some common areas, regardless of time. In an analysis by Uittenbogaard and Ceccato (2012), the city center is a stable hotspot for both violence and property crimes regardless season. Stockholm's city center is rather compact with mixed activities (e.g. shops, offices, and bars) and people converge at the Central Station on their way to and from places. However, there is a variation in time as violent crimes in the city center concentrate during the winter months, and property crimes during the summer months. Nevertheless, a more spread out pattern can be observed for summers as compared to winters. Most of the persistent clusters are found in areas with strong risk for social disorganization, such as low social control. Routine activity theory suggests that the more outdoor activities in which individuals participate, the more criminal opportunities are presented to them. Therefore, areas that concentrate attractors, such as transportation nodes, provide opportunities for criminal acts (Miethe et al. 1991).

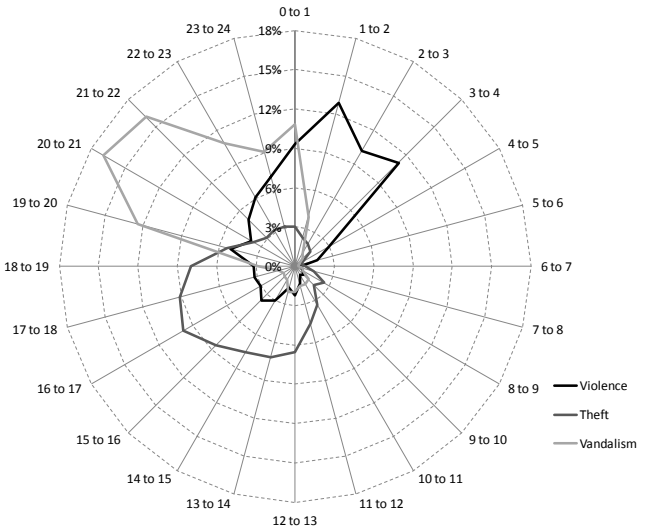
9.2 Temporal patterns of crime at Stockholm's subway stations

September 9, 2012

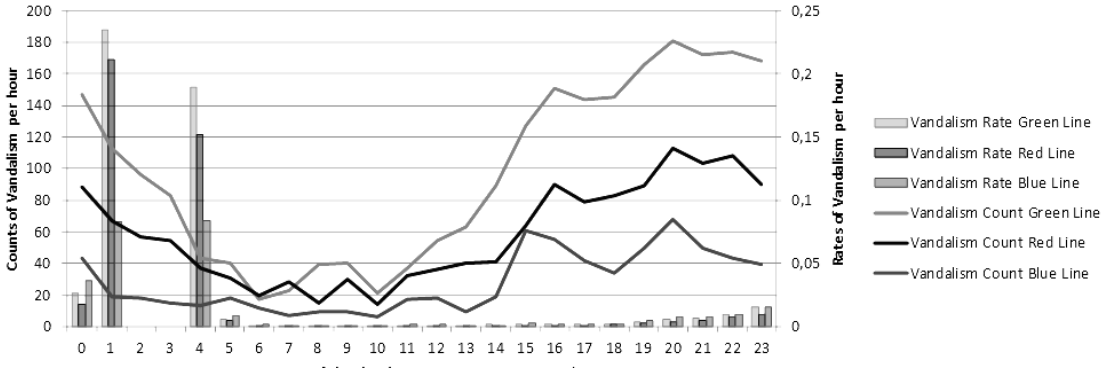
A drunken passenger comes out from the subway train in the early morning of Sunday, September 9, 2012, falls off the platform onto the tracks and hits his head. Unconscious and still on the tracks, he gets robbed by another man who had observed him falling. The robber takes the victim's money, mobile phone, and a golden chain, and leaves the station without alarming subway personnel about the man on the tracks. Ten minutes later the drunken man gets hit by a train, but survives.[19] A few days later, the suspect is apprehended by the police who confirm the robbery of the drunken man and a few others as captured on the subway's CCTV system.

This event is rare in the Stockholm subway network, but it does take place. An event of this kind only happens when people are not around, often in early hours of the day. Although they find variation between 13 U.S. cities, Felson and Poulsen (2003) find that robbery tends to be an evening activity. Is this pattern reflected in the crime events in Stockholm's subway stations?

[19] This event was captured by CCTV at Sandsborg subway station in Stockholm and was the subject of discussion in both the national and international media. The CCTV video can be found at: http://www.youtube.com/watch?v=zKfD-_R10zU&feature=endscreen&NR=1



(a)



(b)

Figure 9.3 – (a) Theft, vandalism and violence offences by hour of the day.
(b) Vandalism by hour of the day for each subway line (Green, Red, and Blue lines).
Data source: Stockholm Public Transport Database, March 2006 to February 2009.

Violence peaks in the evening and at night in Stockholm's subway stations (Figure 9.3(a)). These findings mirror the literature that suggests that conflicts often reach a peak when people meet each other in their free time, during evenings or weekends. Harries (1997) suggests that there might be a *lag effect* on people's manifestations of stress. The stress is accumulated during the day and then *blows up* later, for instance, when people go somewhere else after work. If this is true, then this is an indication that it is not only heat that leads to stress and violence, but also the possibility of externalizing stress, for instance by changing settings (e.g. from work to a bar).

Most reported events that take place in the Stockholm subway actually occur in the late afternoon and evening, more precisely between 4:00 pm and midnight, regardless of data source. These variations and peaks are related to people's routine activities during the day. During periods when people are on the move, there is a greater risk of victimization. This is because there is a greater chance of potential victims being in the same place at the same time as motivated offenders.

If one takes the example of events of violence in the three subway lines (Green, Red, and Blue lines in Figure 9.3(b)), a similar pattern is identified over the hours of the day, but with different gradients. The green line has more stations than the two other lines, which affect the counts of crime in a number of ways: first, some of green stations are open longer than the rest of the subway system, which also affect the line's criminogenic conditions; second, the green line is embedded in a couple of high crime neighborhoods. The crime rates by passenger vary according to immediate surroundings and geographical location in the city for each subway line.

Table 9.1 - Average crime events per day: weekends, weekdays and holidays.

Type of the day	Theft	Vandalism	Violence	Public disorder	Other
Weekends	0.15	4.19	5.14	40.19	11.13
Weekdays	0.13	3.18	2.78	29.06	7.76
Holidays	0.38	8.77	12.41	80.43	23.58

Data Source: Stockholm Public Transportation (2006-2009).

Holidays and weekends are more vulnerable to crime and public disorder events than weekdays. People often engage in *unstructured activities* during weekends and holidays that tend to be more criminogenic (e.g. going to parties and drinking) than the ones performed during *normal* weekdays, which are filled with *structured activities*, such as going to school and work (Tables 9.1 and 9.2).

Table 9.2 – Differences in crime: weekends, weekdays and holidays -(One-way Anova with a post hoc Scheffe test)

Type of the day	Crime Events	Crime Average/Day	F-test	Scheffe
Weekends (1)	29259	48.28	2560.828*	1.3
Weekdays (2)	27823	61.69		2.3
Holiday (3)	5152	132.10		3.1/3.2

* Significant at 99% level.

Data: Stockholm Public Transportation (2006-2009).The number in parenthesis (first column) gives reference to the statistical significant differences between weekends, weekdays, holidays indicated in the last column.

Most crimes are seasonal, in other words, they tend to occur more often during certain periods of year than others. These temporal variations seem to be more related to changes in routine activities of individuals (e.g. vacations and holidays) than to environmental changes caused by weather variations as suggested, for example, by aggression theory[20] (see e.g. Anderson et al. 2000). The Stockholm data indicates that at least violent crimes are seasonal (e.g. robbery, fights, and violence) in Stockholm's subway stations. In particular, more violent crimes seem to occur in the autumn months.

Table 9.3 - Differences in crime (all types) by season - (One-way Anova-post hoc Scheffe test)

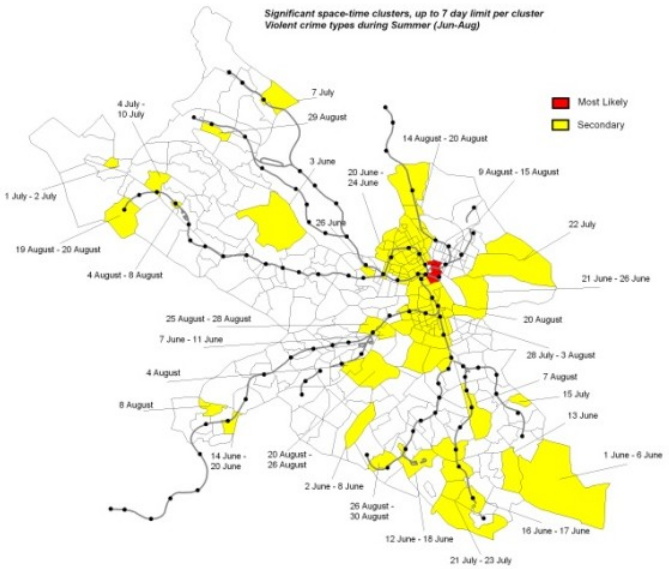
	Crime Events	Mean Crime Levels	F-test	Scheffe
Winter (4)	17145	2.55	2560.828*	4.1/4.2/.4.3
Spring (1)	15787			1.2/1.3/1.4
Summer (2)	13503			2.1/2.3/2.4
Autumn (3)	15830			3.1/3.2/3.4

* Significant at 99% level.
Data: Stockholm Public Transportation (2006-2009).
The number in parenthesis (fist column) gives reference to the statistical significant differences between weekends, weekdays, holidays indicated in the last column.

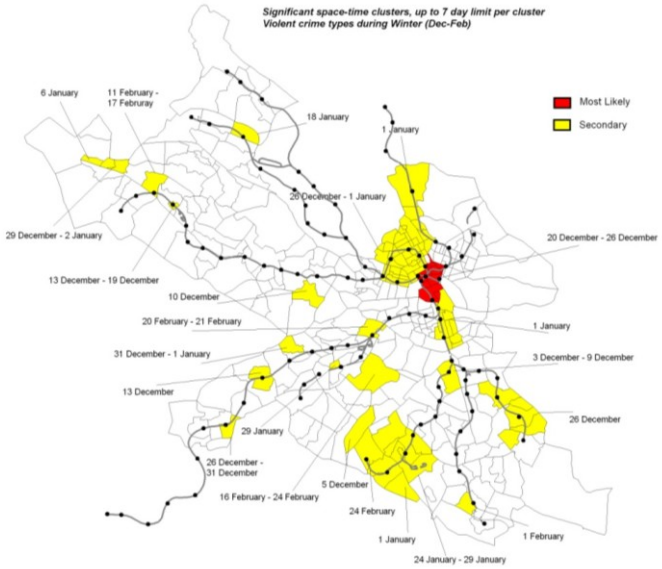
Crime at stations varies seasonally (Table 9.3), but data sources show different concentration patterns. While police statistics show differences between winter and summer in favor of the warmer season (with more crimes), which corroborates Quetelet's (1842) early results, the SL data indicates that the greatest number of crimes against a person is committed in winter. Low temperatures force passengers to wait for trains indoors at the stations, creating situations more prone to violence than in the summer. Dark and snowy winter days make citizens take public transportation instead of cars more often. Another, less likely, reason for this mismatch between the police and the SL data is that the police data covers a 100-meter area around the stations (which often includes the station area and both entrances), while the SL database only includes events that happen at the stations.

Time variations depend on crime type. For instance, better opportunities for theft appear in the spring when people start going out more often, as compared to winter and autumn. For vandalism, rates rise during the colder months of the year, as, even for the offender, it is more comfortable to be indoors. Regardless of which season shows the highest concentration, the literature relates variations in crime to the influence of weather on human behavior (e.g. Anderson et al. 2000) and/or to changes in people's routine activities over the year (e.g. Ceccato 2005).

[20] The theory suggests that weather variables, but particularly temperature, heightens physiological arousal and leads to aggressive thoughts and, in certain cases, violence.



(a)



(b)

Figure 9.4 – Most likely and secondary clusters (dark/light grey) of violent crime during (a) summer and (b) winter in Stockholm 2006-2008.
Source: Uittenbogaard and Ceccato (2012a:154).

Figure 9.4 shows the difference between summer and winter after adjusting the spatial limit to 10 percent of the population at risk. Following the Anova test, the space-time scan clusters are somewhat different for violence during the winter and summer. Moreover, the most likely cluster in the city center has clearly shrunk in the summer months when the violent crime clusters, at least the secondary ones, are positioned more in the outer suburbs of Stockholm. Areas in the periphery of Stockholm municipality mainly consist of housing areas with (regional) shopping centers located at transportation hubs, which present steady clusters over space and time.

9.3 Variation in safety perceptions at Stockholm's subway stations

Fear and perceived risk also vary over time. Transportation users feel less safe in certain environments, and a number of studies confirm that such fear intensifies after dark (U.K.Department of the Environment, Transport and the Regions 1996; Smith and Cornish (2006). This might be because more violent crimes happen during the evening/night at transportation nodes. According to Yavuz and Welch (2010), there are often few other passengers on public transportation during night, afternoon, and weekend hours, and this may induce actual crime and fear of crime, as there is less informal surveillance and less help available if a crime happens. Women often list lonely bus stops, unstaffed stations, and pedestrian subways among the places that cause fear. They also report higher perceived insecurity at night while walking in parks and subways, and when waiting at bus stops or platforms in isolated areas (Trench et al. 1992; Lynch and Atkins 1988). The consequences of this are that women may completely avoid the use of certain public spaces, confine their use to certain hours of the day, or visit them only if accompanied by others Loukaitou-Sideris (2012).

Yavuz and Welch (2010) show that peak-hour ridership is positively and significantly related to males' perceived subway safety, but is not significant for females' perceived safety (using data from the Chicago Transit Authority 2003 Customer Satisfaction Survey. The authors suggest that frequent service during peak hours reduces uncertainty in the subway environment and the length of exposure time, thus making men feel safer. Moreover, during peak hours the number of people waiting on the platforms tends to be higher, which may contribute to men's perceived safety as well.

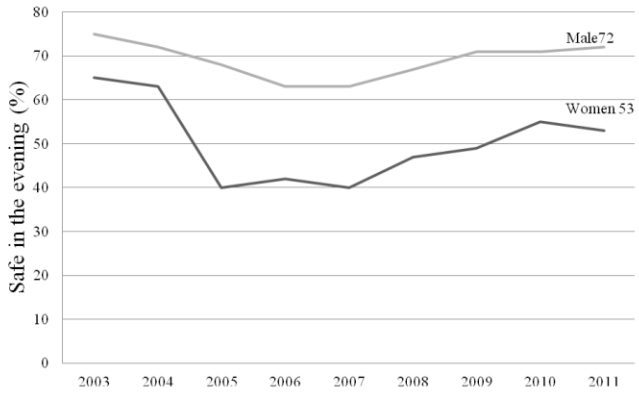


Figure 9.5 – Perceived safety at the stations in the evenings, spring season 2003-2011. Data source: Stockholm Public Transportation (SL) Safety Survey

Women perceive lower safety at the stations than men according to the Stockholm Public Transport (SL) Safety survey from 2003 to 2011, in autumn and spring (Figure 9.5). What is constant is the difference in perceived safety between men and women over time, varying between 12 and 28 percent. In the last five years, for instance, the gendered difference in safety perceptions is evident in all modes of transportation. Similar findings are found elsewhere. Cozens et al. (2004) report findings from the U.K. in which 93 percent of surveyed females report being fearful while waiting on a train platform at night (compared with 53 percent of males) due to low visibility.

In Stockholm, the difference is greatest for subway and commuter trains where only a small majority of women (56 percent on the subway and 53 percent on commuter trains) feel safe when they travel alone during the evening. The corresponding figures for men are 77 percent and 75 percent, respectively. (In buses, the gender difference is smaller; 76 percent for women and 86 for men.)

The dip in perceived safety from 2005 to 2008 in Stockholm's stations is difficult to explain, especially as there are no significant seasonal variations between the spring and autumn data. This might indicate that spring and autumn conditions are perceived as similar, or not as extreme as winter and summer, which hypothetically could affect safety perceptions. For instance, during midwinter in Sweden, darkness and cold prevail (around 6 hours of daylight in Stockholm and an average temperature of −3°C in February). At midsummer, however, daylight takes over with long days in June and July (around 18 hours of daylight and an average daytime temperature of 20–22°C). The seasons limit outdoor activities in winter, but allow days full of activities in the spring and summer. This is bound to affect patterns of movement and urban safety. Since environmental conditions vary over time (e.g. light, vegetation), the expected effects of stations' environmental features (physical and social) on crime and perceived safety should also change over time – a phenomenon that, data permitting, will require further research.

9.4 Modeling crime rates at the subway stations over time

Subway stations are criminogenic places, but certain stations are targeted by acts of crime and disorder more often than others (Ceccato et al. 2011b:18) and a station's vulnerability may change over time. This section reviews the study by Ceccato and Uittenbogaard (2012) which investigates daily, weekly, and seasonal variations of crime at subway stations in Stockholm and tests hypotheses that combine time-geography ideas, routine activity principles and defensible space theory. One hypothesis is that:

The transportation node's specific vulnerability to crime varies over space and time. Offenders perceive a transportation node's environmental features as risky when active guardians are around, during the day or the summer. And stations with hidden corners and low visibility in the night or winter more often tend to be crime targets.

Ordinary Least Squares (OLS) models are built with the natural log of total crime rates (for selected *time frames*) as the dependent variables and stations' attributes as covariates (see Ceccato and Uittenbogaard, 2012, for details). Since different crimes take place during different time windows, these slices of time vary. For daily variations, these *time frames* are based on peak and off-peak hours of passenger flow. The rates for weekdays (Monday – Thursday) and holidays are based on the number of events per 1000 passengers. Holiday rates are based on Swedish public holidays 2006-2009. Seasonal crime rates are based on the numbers of reports for each season by passenger flow; for instance, December to February is regarded as winter, and June to August as summer. Crime data are extracted from the Stockholm police database for 2006-2009. These years are then aggregated in order to create a more robust dataset (keeping the information on hour, day, and month). Administrative, demographic, and socio-economic data are obtained from Stockholm municipality and added to the basic map of Stockholm using GIS.

Table 9.4 – OLS regression results of total crime rates at subway stations (log): daily variation, weekly variation, and seasonal variation models.

Model	Significant variables	Model	Significant variables
Peak hours	R^2 = 53.5, n = 18	Off-peak hours	R^2 = 40.4, n = 14
	Central location		Central location
	CCTV cameras		CCTV cameras
	Few people around		Crowded station
	More hiding places		
	Presence of drunken people		
	Few escalators		
Holidays	R^2 = 81.5, n = 16	Weekdays	R^2 = 81.6, n = 9
	Central location		Central kicatuib
	CCTV cameras		CCTV cameras
	ATM machines		ATM machines
	Alcohol stores		Alcohol stores
	Crowded station		Garbage
	Physical deterioration		Crowded station
	Presence of drunken people		Physical deterioration
			Fewer hiding places
			Presence of drunken people
Winter	R^2 = 80.2, n = 10	Spring	R^2 = 81.1, n = 13
	Central locations		CCTV cameras
	CCTV cameras		ATM machines
	ATM machines		Alcohol stores
	Alcohol selling outlets		Fewer hiding places/blocking view
	Crowded station		
	Physical deterioration		Physical deterioration
	Presence of drunken people		
	Short exits/entrances		

Source: Based on Ceccato and Uittenbogaard (2012:15).
(R^2 = goodness-of-fit, n = number of variables in the model).

Findings provide snapshots of the city's overall risk over space and time using aggregated data. Over the *day,* crime tends to happen during *peak* hours in larger, peripheral stations with hiding spots in the lobby area and the presence of drunken people, and without many other people around. For *off-peak* hours, overcrowding in transition areas of the station affects crime: higher numbers of people at stations tend to be associated with greater levels of crime. There are variations by crime type and season as well (see Ceccato and Uittenbogaard, 2012). For example, for violent crimes during *holidays*, variables such as peripheral stations, stations with cash machines, crowded stations, and the presence of social disorder are signifi-

cant. In the *winter,* when violence rates are highest, violent acts take place in open stations with many hidden corners and littering. During the *spring*, higher crime rates are related to stations with alcohol stores nearby, but unexpectedly to stations with fewer hiding spots. Results suggest that the role of the station environment in crime causation varies over time – an important fact to consider for safety interventions.

9.5 Concluding remarks

Crime opportunities are neither uniformly nor randomly organized in space and time. They follow rhythmic patterns of human activity. This chapter has shown that crimes at subway stations tend to occur more often during evenings, nights, holidays, and weekends. There is also evidence of seasonal variations in crime. In the winter, stations with social disturbance and signs of deterioration show high levels of crime, while in the summer; offences are concentrated at stations near alcohol stores. During daily peak hours, stations with hiding spots are often targeted by criminals, but during holidays, crowded stations and those with alcohol stores nearby attract more criminal activities. Findings from Stockholm indicate that the role of the stations' environment in crime causation varies over time, which is an important fact to consider for safety interventions, which are discussed in the next chapter by crime type.

Chapter 10
Lessons from the Stockholm's subway stations

What does this book tell us about crime and perceived safety at transportation nodes? This chapter discusses the general picture of spatial and temporal patterns of crime and perceived safety at subway stations. Results are reexamined in the light of the main theories that support the empirical analysis in this study. The book advances the knowledge base in safety in transportation nodes by contributing evidence of a subway system in a Scandinavian city – a research area so far dominated by North American and British examples.

10.1 Integration and discussion of findings

In later sections, based on the findings presented in Chapters 7, 8 and 9, suggestions directed towards safety improvements at Stockholm's transportation nodes are put forward. Although some suggestions are general and may be applied in other contexts, they have a particular meaning within the Stockholm subway system.

Crime and disorder at stations

Crime and perceived safety at a station are functions of both the internal conditions of the transportation node (physical and social environment) and the physical infrastructure, services, and activities that compose it. This confirms the initial assumption that stations are node places, as suggested by Bertolini (1996).

According to Bertolini's adapted model, stations that are not able to control levels of crime and disorder and make passengers feel unsafe are *under stress* or unbalanced. It was expected that central stations would fit into this classification more than peripheral ones. However, although the highest numbers of events are found in the Central Station and some other inner-city stations, the so-called *end-stations* show higher crime rates than those located in the inner city; some of them are also perceived as unsafe. Since most of these peripheral stations are located in disadvantaged neighborhoods, these findings lend weight to the importance of the stations' immediate surroundings and their neighborhood contexts, stemming from principles of social disorganization (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. LaVigne (1997) shows, for instance, with the exception of assaults, that subway crime rates by station do not directly vary with crime rates for the census tracts in which the subway stations are located.

Interestingly, according to the node-place model, signs of unbalance are also found when comparing perceived safety at the station with perceived safety to/from the station. Individuals tend to be more satisfied with the station's safety conditions than with those found on the way from/to the station. There are also surprising mismatches between crime rates and perceived safety. A couple of stations show low rates of crime, but unusually poor perceived safety ratings; or the opposite, high crime rates and relatively high perceived safety ratings.

The Stockholm case shows that a relatively small share of reported events is *crime*; acts of public disorder are more common at the stations. Most of these events have particular *time signatures*; in other words, they occur in particular time windows. In general, crimes at subway stations tend to happen more often during evenings, nights, holidays, and weekends, when most of the so-called unstructured activities take place. For instance, violence peaks during the evening and night, which suggests that conflicts often reach a peak when people meet each other during their free time, during evenings or weekends (in other words, from a *lag effect* on people's manifestations of stress). Therefore, these results support both aggression and routine activity theories (Cohen and Felson 1979; Harries 1997).

Differences in the environments of the stations and their neighborhood contexts have an impact on the stations' vulnerability to crime and perceived (un)safety. Features indicating barriers to formal and informal social control are related to higher offence rates, such as few people at the station, objects obstructing visibility/surveillance, corners, and hiding places. Good illumination and less presence of physical and social disturbances are often related to lower rates of crime and social disorder events. The city context of these stations is also important to the stations' vulnerability. Stations are more often targeted by crime and disorder when they are located in more peripheral neighborhoods with higher housing instability, higher population density, and fewer police stations. These results, although relevant for crime prevention, do not take into account the variation of crime over time.

The Stockholm findings indicate that the role of the stations' overall environment on crime causation varies over time, which is an important fact for safety interventions. In the winter, stations with social disturbance and signs of deterioration show high levels of crime, while, in the summer, offences are concentrated at stations near alcohol stores. Seasonal differences in people's routine activities certainly play a role in a station's vulnerability to crime, particularly violence.

Situational crime prevention assumes that situations in which crime occur, their stability and predictability make these situations good targets for crime prevention efforts, much more than those actions focused merely on individuals (Weisburd et al. 2011). In Stockholm, an example of such stability is found in the city center, but also in some peripheral areas. The city center is a stable hot-spot for both crime types (theft and violence) during different seasons, and there is a mixed use of activities and people that converge at the Central Station on their way to and from places. The Central Station is both a crime attractor and a crime generator (Brantingham and Brantingham 1993; 1995). In this node-place, the large number of crime or disorder events is principally due to the large number of place users

and targets. The surrounding area, composed of the main square, attracts individuals with different levels of criminal motivation (e.g. Sergels torg, with bars and restaurants nearby, is a known hang-out for drug dealers).

In the periphery, most of the persistent clusters are found in areas with strong social disorganization risk factors and low social control. In this context, subway stations become crime generators. For example, they are popular places where young people hang out after school hours and during weekends, and where vandalism and/fights may take place.

Perceived safety at stations

The patterns of perceived safety at subway stations are dependent on the physical, demographic, socio-economic, and criminogenic conditions of the transportation node and its surrounding areas, including the neighborhood context.

Although stations that are perceived as unsafe tend to be more criminogenic, high crime rates alone do not explain patterns of perceived (un)safety. Modeling results show, for instance, that perceived safety at the *unsafe* stations is associated with visible social disturbance in lobbies, low surveillance, and higher rates of violence and events of public disorder. On the other hand, *safe* stations are associated with fewer platforms and exits, but also, as previously hypothesized, with effective formal social control either through CCTV cameras or the presence of guards. These findings confirm the influence of the micro-spaces of transportation nodes on perceived safety in the system (Atkins 1990; LaVigne 1997; Loukaitou-Sideris 2006; Smith and Cornich 2006).

Unsafe stations in Stockholm are often located in neighborhoods with more social problems and high housing mobility. Some of these social factors are also behind low ratings of perceived safety on the way to/from the station. Researchers have found that perceptions of risk and fear are generated by neighborhood incivilities, distinguishing between physical incivilities (e.g. deteriorated or abandoned buildings, litter, graffiti) and social incivilities (e.g. public drunks) (Loukaitou-Sideris 2012). In the U.K., passengers often feel intimidated or threatened by the rowdy behavior of young people (U.K. Department of the Environment, Transport and the Regions 1996).

Those who feel unsafe at subway stations are generally women, adults, individuals with children in the household, and respondents born abroad. Although expected, these findings provide indications that safety interventions at transportation nodes may fail if differences in people's perceptions are not regarded as indications of differences in safety needs. (For other evidence of how perceived safety at subway stations varies by group, see, e.g. Box and Hale 1988; Koskela 1999; Fyhri and Backer-Grøndahl 2012).

While clusters of perceived unsafety at transportation nodes are concentrated in the periphery of Stockholm for some groups such as women and individuals born abroad (in the northwest parts of the municipality) and young people (in the southern parts), for the elderly, the stations perceived as unsafe are centrally locat-

ed. Further research is needed to explain why perceived safety vary geographically by group, but one possible explanation that applies to all groups is familiarity with the geographic area. The literature indicates that familiarity with an area and a transportation mode is an important factor that influences perceived safety. In the U.K., those who frequently use public transportation feel safer than infrequent users (U.K. Department of the Environment, Transport and the Regions 1996).

Individuals tend to feel safer in their neighborhoods than at the subway stations. However, the stations are perceived as safer than the environments the individuals are exposed to on the way to/from the stations. These findings highlight the importance of adopting a whole journey approach when assessing perceived safety, but also that in certain high crime areas, subway stations are perceived as *safe realms* relative to the rest of the neighborhood.

In the next section, suggestions to tackle individual crimes and overall safety are presented. They are based on the modeling results presented in previous chapters as well as on theories within environmental criminology, situational crime prevention, urban design, and fear of crime.

10.2 Tackling individual crime and overall safety

Good urban planning can make daily trips safer for both passengers and personnel. Knowing about crime and disorder at these stations is important but not enough. In the next pages, a selection of suggestions is put forward as a starting point for action. For action to occur, planners and practitioners must be aware of their roles and the challenges involved when working with specific safety issues. They should strive to work towards practices that are inclusive and fair (e.g. addressing different target groups together with a coalition of different actors) and, as much as possible, to work on participatory frameworks.

There are a number of strategies that can be developed to maximize the positive and minimize the negative physical characteristics of particular settings, thereby contributing to greater safety for passengers. Drawing upon results from Chapters 7, 8 and 9, detailed suggestions for interventions that can help reduce and/or deter acts of vandalism, public disorder, violence, and property crime in subway stations are summarized in Table 10.1. Identifying types of stations that are more vulnerable to crime (or perceived as such) and considering the contexts in which the stations are embedded (neighborhood and city contexts) are crucial for place-centered actions.

An exhaustive list of recommendations is suggested for each crime type. In reality, it is unlikely that the authorities have the capacity to implement this list in its entirety. This session try instead to discuss which recommendations can be implemented at short run and how authorities can move towards adopting the more difficult ones in the future. The difficulty of implementing these recommendations varies by the type and intensity of the problems. The effectiveness of these initiatives is however patchy. What is known is that they are better tailored towards the

specific situation in Stockholm, but some recommendations, it is argued, would work as examples to other subway stations elsewhere.

In this section, an attempt to demonstrate why these recommendations may work particularly well in the specific context of Stockholm is motivated. For instance, significant differences in temperature and light over the day and between seasons (e.g. long days in the summer and long nights in the winter) are bound to have a stronger effect on people's routine activity and therefore on crime patterns than in cities of tropical or even in temperate latitudes. Thus, some of the interventions devote particularly attention to the temporal dimension of safety.

Vandalism

Interventions can consist of improving the physical environment, increasing surveillance, and enhancing indirect crime prevention. In the case of the Stockholm subway, vandalism is related to smaller and less crowded stations, as well as stations away from the city center, such as *end-stations*. Thus, these stations deserve more attention when attempting to prevent of vandalism. Action should be focused within the time window 7-10 pm, as most vandalism occurs between these hours (see chapter 7). A list of actions that may help prevent vandalism the Stockholm subway follows:

- *Check the quality of illumination in all parts of the station premises* - Poor illumination in transition areas is linked to higher rates of vandalism. Better illumination and windows decrease the offender's feeling of being out-of-sight, which affects his/her decision to vandalize public property. Because of daily and seasonal differences in sunlight in Stockholm, better illumination would increase the opportunities for natural surveillance and, thereby, increase the risk of being seen while applying graffiti or damaging objects in these otherwise dark areas.
- *Improve visibility and surveillance* - Transition areas are vulnerable places per se, as visibility is often low and ubiquitous bare walls/windows provide perfect spots for graffiti. Improved opportunities for visibility and surveillance need to be implemented. Besides lighting improvements, see-through walls, and clear lines of sight, it is also desirable to invest in design that allows good visibility from outside the station. Formal surveillance by CCTV cameras deters vandalism. In Stockholm, the smaller stations often have fewer cameras installed, and the stations with particularly high crime rates have fewer CCTV cameras (11-17 cameras compared to an average of 29). A careful audit should provide a basis for the installation locations of new CCTV cameras. The visibility of CCTV cameras for passengers also affects perceived safety. Therefore, locating CCTV cameras to make them more visible should be encouraged since, according to previous research, they also have a positive effect on the overall safety of passengers and personnel.
- *Use graffiti- and damage-resistant materials* - More vandalism can be seen at stations where platform areas are covered by a rain shield and where the walls are made of rough materials. As suggested by Smith and Cornish (2006), ap-

plying smooth coatings and using materials from which graffiti is more easily removed decreases the rewards for the offenders, as their art will only be on temporary display, making the act less attractive.

Table 10.1 - Crime and public disorder at subway stations: environmental attributes at stations and suggestions for intervention.

Crime	Related features	Actions	Principles
Vandalism	Covered platform** Smaller stations** More CCTV cameras installed** Rough wall material* Poor Illumination* More Deterioration*	. Check the quality of illumination in all parts of station premises. . Improve visibility and surveillance. . Use graffiti- and damage-resistant materials. . Provide information and clear rules. . Handle deterioration and litter. . Create campaigns targeting specific groups. . Provide alternatives for legal graffiti.	Broken Window; Defensible space (CPTED)
Public Disorder	Social disorder* Disturbance* Few schools in the vicinity* More separate platforms** ATMs in the vicinity* Peripheral location** Larger central stations**	. Support on-site from service hosts when children and teenagers are involved in disturbing behavior. . Prevent urination in elevators and station premises, e.g. provide toilets. . Inform passengers about the consequences of inacceptable behavior. . Discourage drink- and food-free vehicles. . Allow for legal street performers and vendors on station premises. . Adopt a holistic approach to safety through cooperation.	Social Disorganization; Broken Window
Violence	More separate platforms** Peripheral location** Dark corners** Hiding corners** Low surveillance** Less crowded platforms* ATMs in the vicinity** More CCTV cameras visible* More CCTV cameras installed* More deterioration* Low foreign population in the surrounding area* High visibility Better illumination	. Improve surveillance possibilities. . Manage land use in surrounding areas. . Reinforce access control. . Separate of passenger flows. . Encourage training for personnel. . Promote safe places for vulnerable groups. . Strengthen formal surveillance in particular places and time windows.	Routine Activity; Rational Choice; Defensible Space; Social Disorganization
Property crimes	High visibility** Hiding places** Peripheral location** Fewer benches** Open layout of entrance** Escalators** Views onto platform from other parts of the station* More housing-dense surroundings* Higher population density	. Remove hiding spots. . Clear signage warning about possible theft and pickpocketing. . Reinforce access control. . Separate flows of passengers. . Strengthen formal surveillance. . Eliminate signs that *nobody is in control*. . Encourage actions from service hosts and shopkeepers. . Strengthen formal surveillance in particular places and time windows.	Routine Activity; Rational Choice; Defensible Space; Social Disorganization

All variables significant at the 10% level; * Significant at the 5% level; ** Significant at the 1% level.
Source: Chapter 7 and 8.

- *Provide information and clear rules* - Posting clear signs at certain spots that state regulations and penalties can make offenders think twice before acting.

For instance, it should be clearly stated that vandalism and graffiti are forbidden at the station and, once caught; one may be fined or subjected to other subsequent legal actions, from six months to four years in prison. However, 'educational' statements at trains or stations should be careful thought since they may wrongly interpreted as a sign that the public authorities are trying to educate citizens through strict rules of conduct.

- *Handle deterioration and litter* - The presence of deterioration should be handled as soon as possible as it can influence offenders to act. Like the well-known *broken window* theory, places already thrashed and littered may influence people to do more of the same. In the particular case of Stockholm, interventions should target weekends, when stations are plagued by acts of vandalism and littering.
- *Create campaigns targeting specific groups* - Campaigns highlighting the responsibility of each individual in contributing to the pleasantness of public spaces should be implemented (e.g. in schools, libraries, youth leisure centers, and daily media) and focus on discouraging vandalism and littering. The key ingredient for success in these campaigns, Smith and Cornish (2006) suggest is to rely in the involvement of multi-stakeholder actions: the school, the municipality, police, other authorities, non-governmental organizations, and individual citizens. In Stockholm, it is no different. Some of the successful initiatives are supported by municipal and regional actors in participatory schemes, involving teachers and parents.
- *Provide alternatives for legal graffiti* - The difference between art and graffiti is that art is done with the permission of the property owner. Graffiti as an artistic expression can become a landmark and an integral part of the urban landscape. However, this requires places where one can freely use walls or buildings for legal acts of graffiti. Some cities allow graffiti in certain areas (e.g. in the outskirts), but impose limits, for instance, by defining zones that have to be graffiti-free. Nowadays, Stockholm County has a zero tolerance policy. But there are exceptions. In Stockholm's metropolitan area there are *The legal graffiti wall* (*Den Lagliga Graffitiväggen*) in Märsta, in Sigtuna municipality, where graffiti artists can apply graffiti on a limited area/wall. The wall is popular, especially between March and November, when youngsters queue for the right to paint on the wall. This area has some rules in order to maintain an agreeable atmosphere for all. A similar legal graffiti wall is found in Alby, in Botkyrka municipality, Stockholm region. Although researchers suggest that graffiti on subway is different from other types of graffiti (since it provides the *reward* of their work being viewed by subway subway patrons across the city, see Sloan-Howitt and Kelling 1997), programs directed to graffiti has lately become a priority. Based on international experiences (see, for instance, Cornish 1994), several police departments in Stockholm work with a database in which they take photos of the graffiti as offender signatures, or *tags* in terms of crime scripts, which can later be compared with previous graffiti of a suspect. If caught, the offender can be charged for all damage with similar features or signatures.

Public disorder

Public disorder interventions are complex as many such acts may not be crimes per se, but rather behavior that makes passengers feel uncomfortable or offended. Nevertheless, there are actions at hand to control public disorder. In the case of Stockholm, these actions should focus on the time window from 3 pm to midnight at the larger stations: in particular, central stations, where several transportation modes (buses, trains) meet, as well as *end line* stations, as follows:

- *Have on-site warnings and support from service hosts to children and teenagers when they become involved in disturbances at the station* - This is the lowest level of formal intervention and is used for minor offences where the individuals admit and accept that they have done wrong and is receptive to advice and support.
- *Prevent urination in elevators and station premises* - Providing clear indications of where to find public toilets in subway stations and surrounding areas is even more important than posting signs intending to stop urination in public places. Since there are many individuals in need of a toilet for health reasons in Stockholm, free-of-charge toilets should be available to paying passengers *within* the transportation system, e.g. after passing in through the ticket gates. This should decrease urination in elevators (a common event at entrances of subway stations) and reduce the risk that the toilets, often located in unattended areas, such as close to parks, become a depository of syringes and drugs.
- *Inform passengers about the consequences of unacceptable behavior and encourage actions that contribute to everybody's welfare* - Clearly listing prohibited behavior at stations can make users aware of their actions and consequences, and eliminates the excuse of not knowing better. It also allows passengers to intervene or alarm security without hesitation. Clear placement of trashcans and signs telling passengers to put trash in the trashcans takes away the excuse to litter. Also, encourage passengers to make their trip and others' pleasant by giving priority seating for elderly and pregnant women, for instance, should be advertised often and clearly.
- *Suggest drink- and food-free vehicles* - Stockholm Public Transport (SL) has a zero-tolerance policy against alcohol use on the underground. Any open alcohol container is taken away by security. However, this does not exclude (already) drunken people from using the system. During weekends, it is common that individuals get drunk and become abusive towards personnel, passers-by, and passengers. Passengers complain that they find bottles, litter, and evidence of drug use at the station premises.

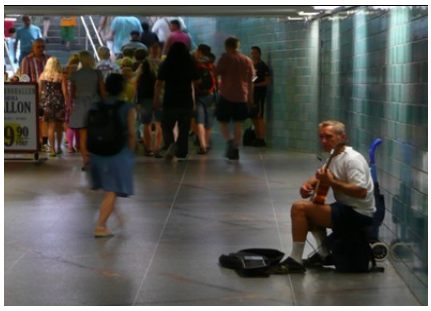


Figure 10.1 – A street performer in the Gamla Stan station passageway, which may provide surveillance and a welcoming atmosphere at the station entrance. Photography: Adriaan Uittenbogaard (2011).

- *Allow legal street performers and vendors on station premises* – Street performing refers to the activity of providing entertainment in public places and sometimes being paid by tips gathered from audiences. Provide designated areas for legal street performers at stations. In this way, passengers will know the performers are legal, which may contribute to a welcoming atmosphere at a public area as well as provide surveillance. As it is know in Stockholm, regardless weather, street performers use areas of entrances/tunnels since they are not allowed to play in platforms or other parts of the station. Moreover, allowing legal street vendors (e.g., coffee places, fruit or flower vendors) in station premises and immediate surroundings may also increase the natural surveillance.
- *Adopt a holistic approach to safety through cooperation* - Safety interventions require cooperation between transportation, safety, and municipal authorities and non-governmental organizations in order to tackle issues that are rooted in structural and long-term socio-economic and land use problems. Within this framework, actions to promote safety must be inclusive since safety is a human right that should be attained by all. The data collected by the Stockholm Transportation Company (SL) shows that about half of the reports of public disorder are linked to drunkards and sleeping at the stations. It is unclear however the composition of this group who spend time at the stations. Although not a new phenomenon, the homeless make use of many public spaces, including transportation nodes and surrounding areas. Among this group, there are the young group that compose 17 percent of the total homeless, often males who have some sort of psychiatric disorder and/or addiction problem (Stockholmstad 2010). Both the police and partner agencies, including non-governmental organizations, are continuously working together to offer support and amenities to those live in the streets. The most recent imitative is called Winter night (*Vinternatt),* which focuses primarily on homeless from other European countries who stays temporarily in the city, and that, until recent past, were not entitled to have a place in existent shelters.

Violence

In Stockholm, stations targeted by acts of violence are the ones with more than one platform and numerous hiding places. Actions should be focused within the time window of 11 pm to 3 am. In June, interventions should be concentrated at Fridhemsplan, Stadshagen, Liljeholmen, Hornstull, Högdalen, and Farsta stations, while in August the focus should be on T-Centralen (Central Station), Kungsträdgården, Hötorget, and Östermalmstorg stations, among others (see more details in Chapter 7). Intervention at Rinkeby station should be focused primarily during January.

- *Improve surveillance possibilities* - Natural surveillance in lobby and exit areas decreases the possibilities for offenders to wait unnoticed for their victims. By creating or improving sightlines, passengers can see what awaits them from afar. Moreover, other passengers or passers-by will be able to notice an offence and get help. Removing objects that block the view are part of this measure. For optimum surveillance, lobbies and exits should not be covered or lined with concrete or brick walls, but instead provide an open space with glass windows and see-through walls with a good view from outside. Have transparent shelters and waiting areas, so that visibility is improved. Many of the older, inner city stations are traditionally built, providing fewer opportunities for surveillance. Engaging shopkeepers and locals around the stations improves the *eyes on the station*. They should be informed and warned of higher risks of violence, so that they can look out for and report events. Moreover, patrols should target the time window of violence, which is from 11 pm to 3 am. In Stockholm, the primary cluster for violence in the winter is between December 20-26 and in the summer August 9-15. Although *end stations* are generally more criminogenic than the rest of the subway stations, centrally located stations such as T-centralen (Central Station) and Hötorget belong to a cluster area that is criminogenic year-round, and may need extra attention.
- *Manage land use in surrounding areas* - The location of ATMs outside subway stations should be rethought since, according to the Stockholm findings, ATMs in the stations' immediate surroundings increase chances of violent encounters. They could be placed in the stations' lobby or entrances instead, where the chances of surveillance is greater than outdoors.
- *Reinforce access control* - The placement of newer electronic gates makes it more difficult to enter the station's platforms without a valid ticket. Guards and ticket controllers make it difficult for fare-dodgers to be in the transportation system. This means that a motivated offender needs to pay to enter the premises, which increases the cost/effort for committing the offence.
- *Separate passenger flows* - Dividing passenger flows will make places less crowded and diminish chances of irritation or conflict. Also, providing separate spaces for vulnerable groups with mobility disabilities, while waiting for the

train or when travelling, in particular, would make trains also accessible to those who are less mobile.

- *Encourage training for personnel* - Train the station personnel to act preventatively, for instance, when a fight breaks out. In this way, passengers can feel safe as they can rely on staff when needed. A ticket issuer at a station explained that they all take a course provided by the transportation company in which employees learn how to react in case of conflicts with passengers and what procedures to follow in the case of violence or harassment. Ticket issuers are not allowed to intervene if anything happens, since it is up to security guards or police to act. In recent years, SL has improved security for its employees by placing CCTV cameras in the ticket booths at the gates. According to personnel, these cameras have significantly decreased harassment and conflicts at the gates.
- *Safe places for vulnerable groups* - Main transfer stations should have special, safe waiting areas during specific times. Providing female-only vehicles can offer a safe place for women in subway system elsewhere but in Sweden, this measure would perhaps considered as exclusionary and discriminatory. Previous research and the findings of this study point out that poor accessibility of subway premises makes women's travel less comfortable, and, consequently, less safe. Disable individuals are also more often victimized than the average interviewed population and they also declare being more fearful in Stockholm. More elevators would facilitate easier access to the subway station for encumbered trips (e.g. carrying groceries/luggage, pushing strollers, or traveling with young children). The same applies to physically disable individuals and the elderly who, for instance, walk with help of walkers, which is commonly used in Sweden.
- *Strengthen formal surveillance in particular places and time windows* - Findings from Stockholm also show that increasing formal social control, for instance, by having guards and police at the stations, increases safety. Formal surveillance patrols can take immediate action and victims are not left without help. Violence may arise when fare-dodgers meet ticket controllers since newly installed electronic gates make it more difficult to enter the station's platforms without a valid ticket.

Property crimes

Property crimes include theft, robbery and burglary. Intervention measures should be concentrated within the time window for property crimes which is from 12 am to 7 pm. Interventions at T-Centralen (Central Station), Kungsträdgården, Gamla Stan, Hötorget and Rådmansatan stations should be undertaken in August, while in October, the focus should be on Skärmholmen, Stora Mossen, and Johannelund

stations. For prevention at Hagsätra station, the focus should be in February (see more details in Chapter 7). The suggestions are the following:

- *Remove hiding spots* - Removing or blocking off hiding spots in transition areas makes it more difficult for offenders to wait for opportunities and provides passengers with an increased feeling of safety.
- *Clear signage of possible theft and pickpocketing* - As Smith and Cornish (2006) suggest for the London case, providing the right information about the risk of theft at highly targeted stations will make it less attractive for offenders to commit a crime on these premises and increase the feeling of safety for passengers. This is particular relevant for Stockholm during the summer time, when the city receives many tourists that are unfamiliar to the subway stations, and may be easy targets for thieves. It is important to advise passengers to be aware and keep track of their belongings, is one of the easy solutions that making it more difficult for thieves to act.
- *Reinforce access control* - As with violent crimes, checking tickets both at entrances and exits, but also on board the vehicles, makes it difficult to loiter within the transportation system without a valid ticket and increases the individual's cost/effort for committing a crime, perhaps past the point of making it worthwhile.
- *Separate passenger flows* - A division of passenger flows will make situations less chaotic and less crowded. Passengers will be more relaxed and focused on their surroundings, making fewer targets available for thieves. It will also create *a strange sight* when an individual behaves differently than everyone else, for instance, by walking in the wrong direction.
- *Strengthen formal surveillance* - Increased presence of service hosts, security, or police will increase the offender's risk of possible arrest. Although service hosts travel around the system network, they are limited in number and may not be present in stations that do attract attention of thieves. Increased security should be focused in the places and time window where and when most property crimes take place.
- *Eliminate signs that 'nobody is in control'* - Unauthorized advertisements on entrance walls may give the impression that *nobody is in control*. Formal and clear regulations for *ads* should prevent clutter and graffiti in environments close to the subway stations. City agencies should keep the sidewalks and areas close to subway stations free of graffiti and litter, thus conveying the message that the area is safe (since locals care about the area).

The actions suggested above are place-centered. The empirical findings of this study show that some stations are more crime-prone than others (at least during certain times, days, or seasons) and can be considered hot-spots. If one can prevent crime at these high-crime stations, then there is a chance to reduce total crime and improve overall perceived safety. However, although some of the suggestions are easy to be implemented, others may require a long term plan of actions by those authorities responsive for delivering transportation services. They can start

with easy environment fixes (e.g. improving illumination or putting signs) and goes towards large interventions in the station's environment and surrounding areas (e.g. those which might require large investments and/or building up of cooperative programs that are not yet in place).

The above suggestions are also focused on crime and disorder at stations rather than within the neighborhood and city contexts. The reason is that neighborhood safety conditions sometimes vary independently from the conditions at the station. Case studies are necessary to accommodate specific local dynamics and needs in order to tackle problems in the station's immediate vicinity and neighborhood. Previous research has shown that the control of criminogenic commodities such as alcohol, cash, and firearms (Cook and Moore 1995) can make a great deal of difference in the rate of crime in limited-access locations like transit systems (Sherman et al. 1998). Moreover, these case studies are not a problem to be addressed by an individual stakeholder, such as the police or municipality. They require the participation of several relevant actors involving both place- and socially oriented initiatives, some of which are already being developed in Stockholm, such as Café Evenings (*Cafékvällar*), Social Action Groups (*Sociala insatsgrupper*), the Calm Street Project (*Lugna gatan*), and public campaigns to improve safety during the journey, just to name a few.

Chapter 11
Making transportation nodes safer

Transportation nodes, such as subway stations, are public places that individuals use on a daily basis and are, therefore, important settings in everyday life. Good planning should aim to make them safe and comfortable for all.

As a researcher or planner, the starting point should be actions intended to have a positive effect on safety in the environment one is acting upon. Such actions must be based on knowledge of what works and does not work. Moreover, one must be aware that safety intervention measures may impose restrictions on space that may be perceived, at least by some, as discriminatory. Often, planning for safe environments may mean that only certain groups, whose voices are legitimized and turned into policy responses, will benefit from an action. Finally, and most importantly, one must strive towards safety for all so that urban environments become livable places. These assumptions, when taken together, are far from unproblematic and illustrate the difficulties in working with safety and the constraints imposed on achieving that goal.

In the next sections, a number of practical examples from Stockholm are presented. The selection of examples is based on the assumption that a subway station is a node-place in which the environments of the station and its surroundings play an important role in defining its safety. This chapter summarizes suggestions that are aimed at improving safety at transportation nodes. Finally, since mobility is an individual right, a relevant question to ask is: safety for whom? As shown in the Stockholm case, the special safety needs of the elderly and the disabled, for instance, should be taken more seriously than they currently are by public transportation service providers.

11.1 Current safety practices at transportation nodes

Ensuring safety along the entire journey is not a task for a single stakeholder group. In the Stockholm case, safety depends on the coordinated cooperation of transportation service providers, police, private companies, local crime prevention councils, and NGOs, just to name a few. For example, the county council-owned Stockholm Public Transport (Company) (SL) is responsible for the county's public transportation network (more than buses and subway; also trams, boats, and commuter rail). The operation and maintenance of the public transportation systems are delegated to several private contractors (e.g. MTR currently runs the subway trains and *Jernhusen* is in charge of the stations).

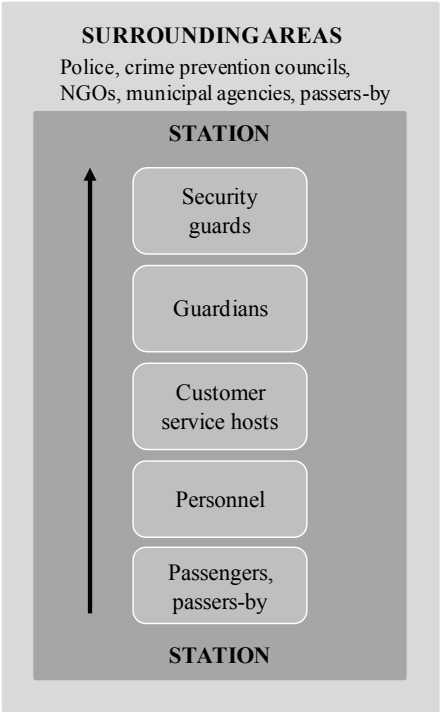


Figure 11.1 - Stockholm's safety agents at the subway station and in its immediate vicinity.

At the station, only security guards have the right to arrest suspects in a potentially criminal situation, which are later handed over to the police force. Customer service hosts have guardianship and surveillance roles (Figure 11.1). It is believed that the presence of customer service hosts provides a human face to the basic transportation service and increases traveler safety. These customer service hosts move across the network and work closely with other personnel (ticket controllers, drivers, and traffic management). SL manages the safety conditions at the stations and during the trip (in the vehicles), but is not responsible for safety in the area in which the station is located, which is traditionally regarded as police domain.

However, in practice, the company running the subway has two ways of working with the stations and their immediate surroundings. One is the constant and long-term attention required by large transportation nodes in general (such as Gullmansplan, Fridhemsplan, and Slussen stations), as they often concentrate a number of safety challenges. These stations require extra resources since they are centrally located and concentrate many travelers from multiple modes around the clock. The second safety strategy is to work with specific stations that need more attention (e.g. on the Blue and Red lines), as some of

these are embedded in high-crime neighborhoods and/or have low perceived safety. Putting these two safety strategies into practice requires tight cooperation between SL and other stakeholders. As expected, the police and other actors (e.g. schools, crime prevention councils, social services, and NGOs) have active roles to play in ensuring safety in the station environments, although their roles are more sporadic (e.g. during special events) and less geographically limited than that of transportation service providers (Figure 11.1).

An eminent question here is: Who is in charge of the safety conditions in the immediate vicinities of transportation nodes? While actors' responsibilities for safety conditions at the subway station are clearly defined between private and public companies, the responsibility for safety in the surrounding areas is a *grey zone* that lacks consensus. First, because there is a range of actors that are supposed to share the responsibility of dealing with safety problems together with the police, who are traditionally the major actor in public safety. This unclear assignment of tasks creates a *grey zone* in which few actors are willing to take charge of problems or share costs beyond their predefined roles.

Much of the practical work done with safety in the areas surrounding the subway stations takes place under district authority (*Stadsdelnämnd*[21]). Anything done at district level is determined by local priorities, which means that the most problematic stations are not necessarily the ones receiving the most attention or resources, since the transit environments are not a priority. According to the expert for safety issues at the Stockholm City executive office, some districts have succeeded better than others in establishing the cooperation needed to intervene[22]. One of the actions that many have contributed to the success of some districts is the use of place-based information of residents' perceived safety. However, explanations for the districts' success are not always known because of lack of assessment of their interventions, and, if assessments exist, they are fragmentary and patchy, as other types of safety interventions initiatives.

Local Safety Initiatives

Below are a number of examples of local safety initiatives that rely on the cooperation of local actors in order to ensure safety at the stations and in the sur-

[21] Stockholm City is divided into 14 districts by geographic area. The district administrations are responsible for some issues, such as municipal pre-schools, elderly care, support and services for disabled persons, psychiatric services, urban maintenance (e.g. maintenance of parks), and recreational and cultural activities. The districts are controlled by political committees, which decide how to allocate money to meet local needs.

[22] One important instrument for intervention has been the Stockholm safety survey, which has not only created a database of safety indicators for the different city districts, but has also established a dialogue between the city administration and the districts regarding safety issues, including safety at transportation nodes.

rounding areas. Some are related to changes in the physical environment while others are based on establishment of cooperative frameworks. It is possible to create a topology for these safety initiatives. The first type is composed of initiatives that focus on different aspects of *situational crime prevention* while the second one is characterized by actions associated mostly with *social crime prevention and long term actions towards young people*. The third type of initiatives is constituted by actions that have a *holistic and user-focused approach to safety,* often more focused on perceived safety and passengers' welfare. Each type is discussed in more detail below.

- *Improving street and park illumination* – The city of Stockholm has worked towards improving accessibility and lighting in different ways (Stockholm City 2010). With long, dark winters, *correct lighting* is fundamental: (1) direct lighting that throws shadows and makes the place feel accessible, (2) logical structure, in other words, lighting that conforms to the place so as to make it comprehensible, (3) good quality with warm colors, and (4) screened lighting that eliminates dazzle. Although illumination is not the only solution for safety, it does contribute to it in Scandinavian cities.

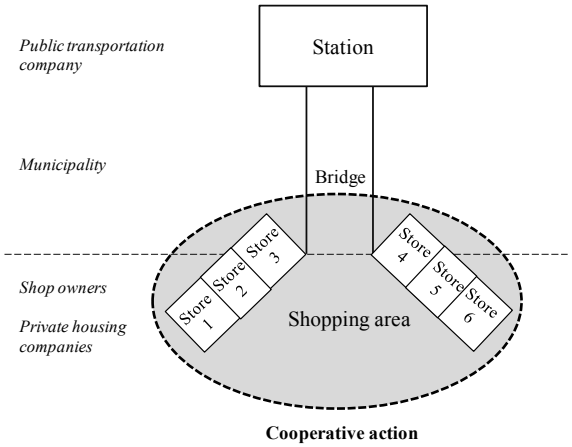


Figure 11.2 – Actors in a node-place (station and surroundings) where cooperative action facilitates the work in tackling graffiti: Haninge, Stockholm region, 2013.

- *Cooperation of multiple actors to reduce the costs of physical damage and increase surveillance* – Ensuring safety in a node-place (station and surrounding area) often requires actions by several stakeholders: the transportation provider, police, municipality, etc (Figure 11.2). In Haninge, a municipality in the Stockholm region, the cooperation between local private actors (shop owners and private housing companies) in sharing costs of graffiti and vandalism has helped them to better deal with these problems. It has also increased their awareness of what is happening in the area, in other words it has improved

natural surveillance. This is a good example of showing the local community that local actors are in control.

- *Construction of the Mountain Railway* (Bergbanan) – The municipality, the Easy Access project, and a housing company cooperated to build new tracks and stations linking a terraced area, which is close to a subway station, to a housing area that is located on steep terrain. This railway service, offered since 2001, has a car carrying 35 passengers. The glassy cabin allows full visibility. Should anything happen inside the cabin or at the station, CCTV cameras record everything. An emergency button connects to an operator who can see and hear what happens in the cabin via a display screen. Improved crime statistics have made it an example of a successful project not only at the station, but also in the neighborhood (City of Stockholm 2010).
- *Calm Street Project* (Lugna gatan[23]) – Started in 1995, the initiative's goal is to prevent violence and fights in the Stockholm public transportation system. The working method is based on close contact with young people and a demonstrated strong commitment to them. This allows the young hosts to prevent fights at stations. Today, the initiative has more than 20 hosts in Stockholm. They work in groups of three and are easy to identify in public transportation environments during the evenings and weekends. Extra resources are placed at crime hot-spots and over long weekends and holidays. The hosts work to prevent violence and vandalism and to be good role models for young people.
- *Café Evenings* (Cafékvällar[24]) – The company responsible for running the subway trains started these informal meetings at the stations in 2011. Café Evenings offer opportunities for the company to have a dialogue with travelers and discuss how one can make the subway safer. They started the initiative in order to discuss safety at problematic stations, particularly at *end stations*. Nowadays, the meetings are open for varied discussions, from strategies to stop fare-dodgers to subway punctuality. These meetings contribute to their collaborative work with the public transportation company (SL), the police, and their own security resources at the stations.
- *Social Action Groups* (Sociala insatsgrupper[25]) – Since 2011, the government has commissioned the National Police Board to develop a social intervention pilot project targeting young people at risk of becoming criminals. This may involve strengthening the social network around the young people and offering help with vocational training, work, hobbies, and special assistance in school. The work of these social action groups is unique in that it is structured, focuses on individuals, and involves many stakeholders; social services work together with the police, other authorities, and voluntary organizations.

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[23] http://lugnagatan.fryshuset.se/om-lugna-gatan/

[24] http://www.mtrstockholm.se/nyheter/cafekv-llar-med-trygghetsfokus-p-t-centralen

[25] http://www.polisen.se/Om-polisen/Uppdrag-och-mal/Sarskilda-satsningar/Sociala-insatsgrupper/

- *Needle and Syringe Program* (Rena spruttor[26]) – Since November 2012, the Stockholm County Council has approved an attempt to offer new, clean syringes to drug addicts, as has been done in southern Sweden for a long time. This initiative aims to prevent the spread of blood-borne diseases, such as hepatitis and HIV, but there are several other motivations behind this action. First, it decreases the risk that syringes are left in public places (often in public toilets and/or subway stations), as there have been cases in which passengers have come into contact with syringes left on benches in the subway system. Second, and perhaps most importantly, it provides increased contact with and support for the addicts.
- *Public campaigns to improve safety during the journey* – Recent popular campaigns in Stockholm (Figure 11.3) include posters in stations, subway cars, and buses requesting passengers to engage in a more safe and pleasant trip, for instance, thanking passengers for opening up space for embarking passengers or for making sure that disabled and elderly passengers have access to designated seats.

Figure 11.3 – Example of a campaign in Stockholm transportation system. "*700-thousand thanks!"We want to thank you for moving further back in the bus. More people can sit, making it easier to get off the bus, and that contributes to smoother transportation and a nicer trip*.
Source: http://sl.se/Resenar/Resegaranti-resevillkor/Roligare-langst-bak-i-bussen/

- *Cooperation towards understanding gendered perceived safety in the neighborhood* – Hallunda-Norsborg, two neighborhoods in the Stockholm region, had an initiative to investigate both risk of crime and areas perceived as unsafe, including areas close to transportation nodes. Marketing campaigns and contact with local actors, schools, and NGOs encouraged residents to fill out a survey, which provided the basis for the analysis. Women and men responded to the following question: *Have you avoided walks in the evening and at night because you are afraid (or anxious) of being victimized?* This is especially important in an area such as this, where unemployment and feelings of isolation are high (Botkyrka municipality, 2010). This case of Hallunda-Norsborg is an

[26] http://nyheter24.se/nyheter/politik/719208-m-kritiken-sprututbyte-stjalper-manniskor

example of how safety and gendered actions must be sensitive to local needs and the demands of different groups. Sweet and Escalante (2010) point out how traditional responses to demands for improved safety may generate unexpected results when ignoring different interpretations of personal and community safety. One way forward is to implement actions that go beyond gendered needs and also include needs that are determined by differences in age and disability, particularly in segregated, less privileged neighborhoods.

- *Changes in the urban landscape improve accessibility for everyone* – As previously mentioned, in Stockholm, the municipality looks after the land while the public transportation company runs the actual transportation shelters/bus stops. In recent years, they have cooperated to improve and rebuild many bus stops in order to make them more accessible. Among other things, curb heights have been raised for easier boarding with a wheelchair, wheeled walker, or pram. Moreover, high-contrast marking helps people with visual impairments see individual steps on flights of stairs (with handrails on both sides) more clearly.
- If a person suffers from incontinence, just going shopping or meeting friends often calls for meticulous planning. Where's the nearest toilet? The brochure *Public convenience (Offentliga toaletter) lists* 223 Stockholm toilets, describes their accessibility, and provides their addresses and opening hours. Some 80 percent of them are designed for wheelchair access. Incontinence is more widespread problem among the elderly, but a lot of young and middle-aged people are also affected. Nearly a million Swedes have incontinence problems, and it has been estimated that one out of every four women aged over 35 is affected at some time in life.
- *A new navigation system to aid visually impaired persons* (*e-Adept*) – The project for the new navigation system was started up in response to wishes from visually impaired persons for something which would make it easier for them to find their way around town. One problem with the systems already commercially available is that they lack the pedestrian network database, which the project group considered absolutely essential for good pedestrian navigation and positioning. *e-Adept* is a joint venture by the Swedish Post and Telecom Agency, the Stockholm City Traffic Administration, the Swedish Road Administration, the Swedish Rail Administration, the City of Malmö, and the Swedish Governmental Agency for Innovation Systems (City of Stockholm 2010).

Challenges for cooperation

Current safety practices face two important challenges: the problems with cooperation between actors and the lack of focus on users' needs, particular differences influenced by gender, age and disability.

1) Cooperation between actors

Evaluation of initiatives often remains weak and descriptions of successful projects do not always contain the right information to help other professionals and practitioners select an action and replicate it somewhere else. The problems with cooperation are therefore described here based on the answers given by the professionals and experts of the area through a semi-structured interview (Appendix 6.1).

According to an expert working at the municipality, one of the problems that hinders cooperation in the work done with safety is organizational: general goals are imposed on the district administrations. Although the system is decentralized administratively, activities follow central political goals, leaving little room for individual initiatives. What is at the top of the political agenda today may not be tomorrow, and a successful safety project may cease to exist because of changes in political priorities:

> If the problem is not taken seriously on the local level, the chances of making a case at municipal and regional levels is remote, suggests the municipal expert.

When a safety problem involves more than one administration (municipalities, companies, counties), networks are built to solve that particular problem. The expert believes that:

> the cooperation has to be driven by a specific issue ...the attempts to solve the problem are what drive cooperative network...the network can't exist by itself.

One of the interviewees suggests the there are barriers to cooperation between public and private actors, and especially some resistance against private actors. What needs to be improved in terms of safety in public transportation from the suppliers' perspective is that the transportation system has to be adapted for the future needs of the Stockholm region:

> Politicians need to take advantage of the existing resources in the best way possible, regardless of if they are public or private ...Stockholm is growing every year by about 40,000 new residents. We need to provide the basic infrastructure and this can be done in cooperation with the private sector, suggests an expert at a private transportation company.

Most of the interviewed experts provided examples of their experience of cooperation between the police and the various local, regional, and state actors (what works; what obstacles they are experiencing). The Swedish legislation has to be rethought to allow information-sharing among those working on intervention with youngsters at risk. Fewer barriers (particularly data secrecy) between local authorities would facilitate early intervention. One expert suggests that one of the challenges for cooperation between police and local actors will be the police reorganization taking effect in 2015, when the police authority will become more centralized. According to him, this reorganization will go in the opposite direction of local needs. He is concerned that:

> some of the more problematic areas create great demands on maintaining the local connections with police. Right now we are making an expansive effort to find sustainable interaction strategies with municipalities.

Another problem with the cooperation between local actors is that multiple reorganizations (within the municipality and other public authorities) make long-term cooperation difficult. Priorities may change based on the profiles of the organizations' leaders. Cooperation can also cease to exist because of these new setups (e.g. key public officials lose their authority and are replaced by others who may not know how to drive the issue further). A long-term strategy would be desirable (but not always easy to achieve); one that take the existent barriers for cooperation into account.

2) Lack of focus on individuals' needs

> *For persons with disabilities of any kind, States should introduce programs of action to make the physical environment accessible.*
> From the UN Standard Rules on the Equalization of Opportunities for Persons with Disabilities, adopted in 1993, Rule 5.

In December 1998, the Municipal Council in the City of Stockholm inaugurated a program to promote accessibility, aimed in principle at all accessibility deficiencies in the outdoor environment and on city-owned properties. These deficiencies, it was believed, should be eliminated no later than 2010 in order to make Stockholm the world's most accessible capital. Much happened during that decade-long project; for a summary of the achieved goals, see City of Stockholm (2010). Although the city recently won (together with two other European cities) a prize for good accessibility, challenges still remain. The Stockholm municipality now has two ombudsmen with complementary roles. The first one is to look after the needs of disabled persons, focusing on living conditions and the conditions of participation. Ensuring safe mobility is an important dimension of this work. The other ombudsman's task is to improve the care of the elderly. In both cases, the task is to make sure that these groups can influence their care and how it will be established in practice, including their mobility using public transportation.

All interviewed experts in this study eagerly talk about safety for all, but most of them have difficulty in clearly defining what their organizations currently and specifically do to tackle the needs of special groups. Nearly all experts mention that they do not have a special program to ensure safety for these specific groups. One of the reasons is that their organizational philosophies are to provide good service to all, indiscriminately, and not only to special groups. One of the experts suggests:

> We do not have a program for passengers with special needs. However, one can always ask for help at the station if one needs it ...what is important is to provide general

> information... for the elderly we have provided extra information in housing for the elderly on how one uses the subway[27] (expert, private company).

Some experts working in one of the transportation companies actually suggest that there is a risk for stigmatization of certain groups when *creating special needs programs*. This exemplifies the fact that, far too often, little is said about the risk of exclusion of these same groups when services offered by society assume that individuals have the same abilities to be mobile and/or claim safety in urban environments – which obviously does not fit the reality of certain groups.

A gendered perspective of safety has to be widely defined in order to incorporate both women and men's safety needs. Even though the general assumption is that women are usually more fearful than men, as discussed in previous chapters, the needs, the local knowledge, and the experiences of both women and men have to be considered. On one hand, there is a risk that biased actions might lead to discriminatory praxis. On the other hand, it has far too often been assumed that women and men have identical needs as consumers of public transportation. There are significant differences between women's transportation demands as opposed to men's that justify targeting women separately (Hamilton and Jenkins 2000). At the national level, The Swedish National Board of Housing, Building, and Planning (Boverket) in collaboration with the counties have supported projects to strengthen urban safety from a gender perspective, such as Safe and Equal (*Tryggt och jämt*) (Boverket 2010), but there is still a long way to go. From the gender perspective, safety and equality have tended to be overlooked in municipal planning. For instance, the Swedish National Board of Housing, Building and Planning (Boverket) had a two-year project on safety and equality, but the cooperation in the project did not work very well since participants found that there was little time for reflection either with the National Board, county, or with the other projects that have received support (Boverket 2010:40). Gender, social exclusion, and unemployment are co-identified as contributing to lack of safety. Future initiatives must go beyond this initial diagnostic and make plans of action that include those who are victimized or in fear, for instance, when an individual is using public transportation.

11.2 Suggestions for future interventions

The most important message from this Stockholm study is that safety in subway stations is not only a function of the local conditions, but also of the surroundings in which these transportation nodes are located. This means that safety in subway stations should be tackled by multiple authorities and should aim to

[27] This campaign started after a couple of accidents with injuries occurred at the station's ticket barriers. SL introduced their new, electronic barriers to stop fare-dodging, but they caused some accidents as well, which led the company to change the settings so that the glass doors shut more softly and that the timing between passengers going through the barriers is increased.

safeguard passengers' safety even outside the stations and during the entire trip; this because a trip does not only take place in the subway stations or trains. Passengers need to feel safe while moving to/from home: walking, biking, or waiting at transportation stops. Findings in Stockholm show that while subway stations may be sufficiently protected, the immediate surroundings and routes to these facilities may not always be as safe. Sometimes it is the location of the station that plays a role in determining its vulnerability to crime (peripheral stations are more criminogenic than central ones, although exceptions are found for property crimes). In other cases, other conditions may make some stations more criminogenic than others: certain types of land use (e.g. ATMs in the immediate vicinity) or the stations' internal environmental attributes (e.g. corners, hiding places, poor illumination).

Different actors have different strategies of working with safety in the public transportation system. Representatives from the company that runs the trains, for instance, would expect to place more resources on service hosts and/or security guards as there is a currently a limited number that are placed on demand, where problems occur. Another challenge, according to the company that runs the trains, is to have good knowledge of what to do with the data that comes from different safety indicators, such as the safety survey. The information is not necessarily useful if it is not applied, it was suggested.

From her experience with the Los Angeles transportation system, Loukaitou-Sideris (2012) suggests that actors should adopt *a multi-pronged approach to safety* and indicates 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, neighborhood watch groups, the use of security technology on transportation premises, information, and media campaigns. In Stockholm, the problem of people sleeping in subway cars and premises requires actions that are a result of cooperation between local social services and other non-governmental organizations specialized in homeless persons (e.g. Stadsmissionen), such as providing alternatives for shelter, particularly in the winter. Another example is the problem of vandalism in subway stations, particularly littering. Actions could count on the benefits of anti-littering campaigns driven by schools, but reinforced in public places that often connected to transportation nodes in Stockholm, such as libraries and shopping malls.

Crime and disorder at transportation nodes

Although transportation agencies and other authorities responsible for public environments may not have the power to make structural changes that affect the long-term socio-economic context of the stations (e.g. population density, housing mobility, police patrols in the neighborhoods), this study offers a number of indications of how some specific environmental aspects (design and land use of sta-

tions) may be reconsidered to better promote safety at subway stations. There are a number of strategies that can be developed to maximize the positive and minimize the negative physical characteristics of particular settings, thus contributing to greater passenger safety.

One can identify subway stations in need of intervention. Some urban 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, the Stockholm results show that this pattern may vary by crime type and over time. For instance, thefts tend to be more concentrated in the hot months of the year and violence in the winter. Targeted interventions should focus on the worst first – the locations and times with the highest incidences of crime or risk of crime. For instance, interventions against violence in June should be concentrated at Fridhemsplan, Liljeholmen, Hornstull, Högdalen, and Farsta stations, while, in February, it should be at Liljeholmen, Hornstull, and Hagsätra stations. Detailed monitoring of incident reports, associated with regular safety audits by personnel, transportation agencies, or other municipal agencies could identify the stations more in need of intervention.

It is also necessary to improve visibility and natural surveillance at subway stations and their surrounding areas. It is important to locate and mitigate the features of subway stations that have a large, negative influence on visibility and surveillance: hiding places, dark corners, poor illumination, particularly in transition areas, lobbies, and on platforms. Equally important is the presence of people at the stations and in the surrounding areas. Empty streets and desolate public spaces generate opportunities for criminal acts to go unnoticed. Experiences in the USA show that adequate lighting of streets, parks, bus shelters, and stations can decrease risk of assaults and perceptions of danger. The design orientation of buildings with windows facing the street can increase natural surveillance by neighbors. In mixed land use and commercial areas, design can improve opportunities for surveillance by introducing storefronts facing the sidewalk (Loukaitou-Sideris 1999; 2006).

Another strategy to ensure safety is to eliminate signs that *nobody is in control* and enhance pleasantness at subway stations and their surrounding areas. It is fundamental to regard subway stations as node-places, as suggested in Chapter 3. Findings from Stockholm show that physical deterioration is often associated with high-crime stations, which may indicate that the area lacks social control. Some centrally located stations have elevators that stink after weekends and holidays. Better signs of where to find public toilets at the station or in the surrounding areas should be a must in Stockholm's subway stations. Incidents of vandalism that dominate transportation systems can be reduced through the use of graffiti- and vandalism-resistant materials. Equally important is to provide alternative locations that can be legally used for graffiti. Research also shows that good maintenance and cleanliness of the public environment at the station area convey reassuring feelings to transportation users. City agencies should keep the walls, sidewalks,

and bus shelters free of graffiti and litter, thus proving that the locals are in control of neighborhood public settings and transportation nodes.

Figure 11.4 – Moving safely: an individual need and a right.

Equally important is to adapt safety initiatives to the particular needs of communities and groups of individuals. Different groups have different needs and run different risks of becoming a victim of crime while on the move. Interventions should be tailored to the needs of particular subgroups, as well as the characteristics of the local neighborhoods and the various transportation settings. It is also important to evaluate whether proposed interventions are positively affecting the populations who seem to be more susceptible of being victimized or threatened, and may have the fewest mobility options, such as the elderly. This may include both passengers that spend time at subway stations, but also guards and personnel working at ticket booths.

All the suggestions above should be based on equality principles. An example, as discussed by Loukaitou-Sideris et al. (2009) is the force of a mandate to all public agencies to promote equality and eliminate any other type of discrimination on public transportation systems, such as that against disabled and the elderly persons. This can also be done by starting programs that respond to special groups' needs. Although many changes of the physical environment have improved the mobility of these groups, a whole journey approach is still conditional. Interactions between different organizations and governments are needed in order to set up policies in favor of specific groups of persons and their travel needs.

Perceived safety at transportation nodes

In this book, perceived safety is generally limited to feelings or anxiety related to the risk of being a victim of crime, but it is not completely isolated from other sources of fear. Safety is a function of how well one's senses capture the qualities and constraints of the settings in which one is embedded; be it through eyes, touch, or smell. Stations can be perceived as dark, rough, or smelly. This means that safety improvements have to adopt a holistic approach covering all human senses and tackling basic issues of poor illumination, wall textures, dark corners, dirty floors, and smelly staircases or elevators. These basic hygienic and aesthetic

issues should be taken seriously and given attention by those who are responsible for the environments of both the station and surrounding areas, particularly in the winter. These issues may not have a direct effect on crime, but definitely affect one's feelings in public environments.

An easy solution in theory, but difficult in practice, is to promote a *whole journey approach* to perceived safety. As suggested by the international literature, this can be done by providing good lighting along the way to the stations, creating good visibility, having real-time travel information at the stations, and having good general maintenance and upkeep of the environments along the most important paths to/from stations and other transportation nodes. Again, this requires better coordination between transportation agencies and other institutions responsible for safety in public environments (e.g. the municipality, police, etc.) within Stockholm city but also together with other regional municipalities.

One of the main reasons that people feel unsafe at subway stations is the experience of witnessing violence and disorder. As the Stockholm case shows, some stations have more problems of this kind than others. In the short run, more formal social control would be effective in deterring these disturbances at certain times. In the long run, it is necessary to monitor the stations' immediate surroundings and define actions directed to places/individuals that are the *source of the problem*, for example places where one can acquire alcohol (or drugs) in the immediate vicinity (e.g. alcohol stores, bars). In the case of Stockholm, a share of public disorder is actually caused by illegal drinking and sleeping on station premises. Although this might have a negative effect on passengers' perceived safety, these events are minor in comparison to threats or fights. Even so, sleeping and drinking are not easy problems to tackle since they are related to different groups of people: youth on weekends and individuals with chronic drinking or drug problems. Actions to improve safety have to be inclusive and avoid stigmatizing those who are already in a disadvantaged position in society. One way is rely on professionals that can work in partnership with shelters and social care to deal with the problem.

Similar actions can be applied to vandalism. The mechanisms linking vandalism to neighborhood fear can spontaneously be linked to Wilson and Kelling's *Broken Window Syndrome* (Wilson and Kelling 1982), which suggests that unrepaired damage to property encourages further vandalism and other types of crime, or, at least, shows signs that nobody is in control of a particular area. Campaigns highlighting the responsibility of each individual to contribute to the pleasantness of public spaces and discouraging vandalism and littering should be encouraged (see example in Figure 11.3).

Evidence of the effect of CCTV on crime is inconclusive, but the Stockholm case study is not alone in showing that, at least for perceived safety, the presence of cameras has a positive effect on safety at subway stations. Also, Loukaitou-Sideris (2009a,b) suggests that safety is perceived to be greater when CCTV cameras are installed and visible as well as when more security guards are around. On the other hand, the presence of CCTV cameras and guards might affect safety itself by affecting judgments of risk or by being perceived as privacy intrusive.

Very often, visible surveillance techniques (either digital or human) diminish the feeling of being alone at a station. Surveillance by guards should be increased at stations during off-peak hours (such as evenings) and in desolated areas. Alternatives could be improvements in natural surveillance by having stores and coffee shops at entrances and other activities that attract passers-by.

The surrounding environment is considerably important in explaining why one feels unsafe at a station. Areas with mixed land use tend to impose specific challenges, since some of these activities (such as bars, cafes, banks, stores, youth leisure centers, and community centers) attract more people at certain times of the day than the rest of the neighborhood, thereby becoming more criminogenic. Although meeting places are important resources and a vital part of the social life in the more peripheral communities, they should be well-integrated with other functions of the local town center. For instance, activities in buildings isolated from the rest of community may impose safety constraints on the way to/from the locale. Isolated station parking lots may also be easy targets for thefts of and from vehicles. Another alternative is to focus on the rhythms of activities and functions, so that areas do not become empty during the evening/night. Newspaper stands, restaurants, kiosks, and cafés might be a way to enliven empty working areas during nighttime, which certainly has an effect on nearby subway stations. Findings show that different types of crime exhibit peaks during particular *time windows*. Having knowledge of these time windows also helps tackle the problem since actions can be targeted to certain times and places.

Both levels of crime and perceived safety at subway stations are compromised in high-crime neighborhoods, and residents tend to feel unsafe on the way to/from the station. What can one do? How can one address the neighborhood context? This is a difficult question because safety at transportation nodes in these areas reflects wider city conditions. Trying to solve the problems of safety in these areas is the same as trying to solve the problem of crime and fear in the rest of the city! One way to tackle the problem is to start considering the location of the station in the city context, as suggested in chapter 3. Thus, according to the node-place model, suggestions for safety improvements in transportation nodes located in inner-city areas should differ from those in residential areas on the city periphery. Situational crime prevention measures could be useful in certain areas of city center in order to improve safety, but may not prove useful in others. In spite of privacy concerns, many city centers install CCTV cameras at subway entrances, transportation hubs, and crowded public places. However, such solutions are not enough. For instance, inner-city stations under *stress conditions* need tailored safety plans that fit those particular areas with dense population flows at all times. The cooperation of actors responsible for safety provision is fundamental at stations as well as in other central and peripheral criminogenic areas.

There are environmental attributes that can be improved to promote a more safe feeling. According to the 2008 Stockholm Safety Survey, respondents feeling unsafe on the way to/from the subway stations with the worst perceived safety ratings identify problematic factors such as a lack of lighting on the way, small and

dark pathways running through wooded areas, crossing parks and squares and entrances to the station. Most of them also state that they feel unsafe at the local commercial center, as an unfamiliar environment. Here, obvious suggestions for improvement are placement of better lighting on paths to the stations as well as at the entrances. Safety personnel should not be confined to the station but move in its surroundings.

> I think that if you find a place aesthetically appealing and pleasant, you feel safe there. Lighting is a powerful tool for changing people's perception of places, says the architect at the City Traffic Administration and in charge of lighting aspects in the *Easy Access Project* (Stockholm City 2010)

A parallel but overlapping approach is the implementation of a range of initiatives that make citizens participatory in their own safety, especially on the way to/from transportation nodes. Safety now incorporates voluntarism (people working without receiving payment) through governance. The engagement of actors other than traditional planners and politicians in the planning process has often followed open frameworks of participation and action. Safety audits done during *safety walks* in neighborhoods have been popular in Sweden, particularly in some Stockholm neighborhoods. This has also been used as a way to integrate minorities into the public arena.

The use of ICT technologies can potentially be a resource as well, particularly for groups with special needs. ICT supporting safe mobility for groups with special needs is expected to move from prototypes and tests into products on the market, where anyone who feels the need of such aids would be able to access them (if affordable).

Finally, knowing more about these stations alone is not enough. There is a need to consider the context of actions in achieving desired goals. For this to happen, a planners and practitioners must be aware of their roles and the challenges involved when working with specific safety issues. They should strive to work towards practices that are inclusive and fair (different target groups but also based on a coalition of different actors) and, as much as possible, to work within 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 livable built environment.

Chapter 12
A research agenda for safety at transportation nodes

This study, despite its limitations, is a step forward towards a better understanding of safety conditions at transportation nodes. This analysis also brings together evidence from a Scandinavian subway network, which has so far been lacking in the international literature. Below are a number of suggestions for future research that can contribute to a better understanding of safety at subway stations as node-places. Some of these suggestions are more applicable to the Stockholm transportation system, but most of them are equally applicable to other networks.

12.1 Crime and safety at subway stations as node-places

New modeling strategies

The modeling strategy adopted in this study has proven to produce meaningful results for supporting safety interventions, but future attempts to model crime and disorder rates could instead test the use of composite measures or indices to reflect more general conditions at the stations and in their surrounding areas. For instance, instead of using the individual variables from each section of the stations, one could test aggregate variables as overall indicators for good/poor visibility, formal and informal social control, etc. Future analysis should also take into account how other aspects of the city's geography and the presence of different geographic barriers (such as a lake, a river, or a park) are influential in defining regional patterns of offence, which indirectly affect the safety conditions at a subway station (e.g. they might provide hiding places or escape opportunities for motivated offenders at the stations). Moreover, the nature of certain attributes of both the physical and social environments at subway stations should be further investigated. For instance, guardianship affects crime, but little is known about its nature and how its effect differs in different neighborhood and city contexts. The same applies to the role of CCTV cameras on crime and how their effect may interact with other environmental attributes at the stations. Interaction effects should be tested based on current urban criminological theories.

Future studies should consider how different types of people passing the stations (by crime propensity and by risk of being victimized) become affected by these environments. Situational Action Theory can help further the analysis of the role of the social environment in crime causation (Wikström et al. 2010). More specific descriptions of these environmental attributes, particularly their temporal circumstances for both offenders and victims, will most likely identify which stations prove even more criminogenic for certain types of people.

Topologies and new underlying factors of crime and perceived safety

Although crime and perceived safety may share common denominators, what causes crime and disorder may be different from what generates fear. Stockholm's findings show, for instance, that certain stations exhibit high crime rates but are perceived as a safe (such as Hagsätra station), or vice versa (such as Skärholmen station). Any type of intervention tackling crime and safety demands having detailed knowledge of each station, the context in which the station is located, and detailed information about people's movement patterns over space and time around the station. Attempts to create typologies of the stations, as presented in this study, can be a first step in the work to support changes and improve safety conditions at subway stations. In order to improve perceived safety, knowledge about the needs of different groups living near the stations is relevant as well as an investigation of why they might be fearful. The engagement of these groups in local safety issues per se might be an *effective remedy* for the lack of perceived safety. The effectiveness of various types of local engagement to solve these problems is also worth exploring.

The importance of the environment in the node-place model

The cluster analysis show that the environments around stations in southern Stockholm are the most feared in the whole city. Why is the city center criminogenic but still perceived as relatively safe by many? Future studies should take into account the differences in land use and activities at a transportation node (Figure 12.1) that are criminologically relevant since they will affect the crime patterns of both the node and the surrounding area, as suggested in Chapter 3.

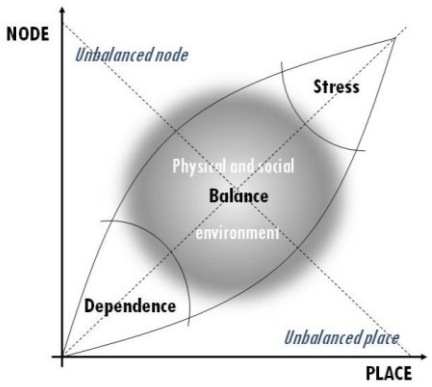

Figure 12.1 – Safety and the effect of the environment on node-places.

Moreover, the assumption of *balance* in the node-place model has to be challenged by incorporating the importance of the physical and social environments at the station (or its surroundings) into the analysis. A balanced transportation node

is the one where both crime and fear of crime are kept under control. Both the size of and the extent of services at the node affect natural surveillance, which is facilitated by the physical and social environments of the station and its surroundings. If the station is perceived as safe, investments will be attracted to it and its surrounding areas (and the opposite for unsafe stations). Thus, a balanced station explores its environmental features, which, indirectly, encourage natural surveillance, which creates safety. An unbalanced station, on the other hand, is and feels outdated and unsafe due to such features as dark corners, particularly in the entrance/exit areas.

Another important issue is that this study does not assess the implications of combined long and short term dynamics in the link between crime and transport nodes. In this study, short term dynamics is analyzed by looking at how daily and repetitive rhythms of activities affect exposure to risk to crime and perceived safety. The book however misses the long term dynamics: people may build up knowledge and coping strategies based on how long they have been using a station. These long term experiences may influence both their risk of being victimized as well as their fear.

Crime and perceived safety varies over space and time

Subway stations are criminogenic places, but certain stations are more often targeted by acts of crime and disorder than others (Ceccato et al. 2011b:18) and this vulnerability may change over time. The Stockholm case shows the advantage of analyzing crime at transportation nodes as *snapshots* of a city's overall risk. Crime at subway stations reflects the rhythmic variations of human activities (hourly, daily, weekly, and seasonally). Future research should assess space-time variations of crime rates at transportation nodes, as well as how they relate to variations in passenger flows and in perceived (un)safety and vulnerability. It is expected, for instance, that environmental features of transportation nodes are perceived as more risky by offenders (and less vulnerable by passengers) when active guardians are around, during the day, or during the summer. On the contrary, stations with hidden corners and low visibility in the night or winter often tend often to be crime targets, raising perceptions of vulnerability. Such space-time assessments will contribute to making more informed decisions regarding safety interventions and allocation of resources.

Data quality and methods of analysis

The use of geographic information in the analysis of transportation nodes has been useful in combination with Geographic Information Systems (GIS). The value of GIS becomes even greater when enhanced with spatial statistical techniques and qualitative information such as perceived safety, as has been done in this book. The limitations of police and other agencies' crime statistics always need to be taken seriously. Equally important is selecting the appropriate method of analy-

sis in relation to the research application's goals, which, of course, is related to the choice of theoretical framework guiding the analysis.

The use of ICT to enhance mobility and safety opens up a number of new research questions. Some are of a technical nature, while others trigger ethics questions surrounding the positioning and tracking of individuals over space and time. For instance, individuals' detailed movement data could help in understanding the link between station surroundings and fear of crime. The Stockholm case has taken an initial step towards identifying what makes subway stations (feel) unsafe. Of particular importance is to investigate why people are afraid on the way to/from the subway stations; here, data collection via ICT can be of assistance.

12.2 Moving safely: a pre-condition for a sustainable city

Stockholm has as a goal of becoming one of most attractive metropolitan areas in Europe by the year 2030 (RTK 2010). This goal requires knowledge to support the sustainable development of the region, particularly from a social point of view. Moving safely is an important dimension of social sustainability. In order to achieve this goal, more knowledge is necessary in various areas discussed below:

The right to move safely

Safety as an individual right, a public good, and a commodity needs to be further investigated in the context of mobility. Safety possesses a dimension of reflexivity, which means that it depends on those who observe and produce it. Thus, a better understanding of safety and mobility of groups with special safety needs (such as the elderly, disabled individuals, and women) is of particular importance for research. These groups themselves are the best sources of information about their own fears, needs, and mobility barriers. Their opinions are taken into consideration in this Stockholm study, but they need to continue to be included in future studies and, more importantly, in planning interventions aiming at safety in transport settings, such as the subway and bus stops.

The needs of the elderly and disabled

Let's take the example of elderly persons. It is difficult to understand the reasons why victimization among the elderly and/or disabled is poorly understood (Aromaa and Heiskanen 2008; Torstensson et al. 2011) when this demographic group is growing[28] all over the world. Mobility decreases as an individual gets older, as does perceived safety (e.g. Piro et al. 2006; Wahl and Gitlin 2007). More than half of fall incidents among older adults occur outside on streets and side-

[28] The global population of people over 60 years old will more than double by 2025 (compared to today). In Sweden, the trend is the same: by 2020, 21 percent of the population will be elderly, now around 10 per cent.

walks, followed by public buildings, gardens, garages, and unsafe walkways in parking lots (Reinsch et al. 1992). Although most accidents happen at or nearby home, there is a lack of empirical studies looking at accidents at or on the way to/from transportation nodes that focus on elderly persons. In Scandinavian countries, dark winters with harsh temperatures and long periods of snow and ice impose special barriers to movement. It is relevant to investigate how the elderly and/or disabled perceive barriers and constraints to movement in space when using public transportation over the course of the year. Previous research has shown that information is a decisive factor in vulnerable users' decisions to travel, especially to unfamiliar destinations. The use of ICT can play an important role in supporting mobility, but it does not solve all problems. Beyond technological solutions, future studies should investigate other alternatives for improving the mobility of the disabled and/or elderly.

From fearful beings to agents in action

While the relationship between women's fear of crime and public spaces has been the focus of considerable research, transit environments, such as transportation nodes, have received less attention. Women often feel more unsafe than men in public spaces. The Stockholm findings show that this includes transportation nodes. Secluded subway stations, dimly lit park-and-ride lots and parking structures, and overcrowded vehicles represent stressful settings for many women, who often feel compelled to change their travel behavior (mode, route, travel time, etc) in order to avoid them. Future studies should devote time to better understand the causes of women's fear at transportation nodes and how to ease women's fear in these environments, for example by using case studies and searching for best practices. Women generally work closer to home, have less access to a car, travel less at night, travel shorter distances, and trip chain more often than men. The same could be said of the elderly and the other vulnerable, less mobile groups. In the particular case of Stockholm, a question to be answered is: why do women and foreign-born persons fear the environments around stations located in the western parts of the city in particular? The regression models give some clues but further research is needed. A way forward would be to track people's movement patterns over space and time and see whether this data can explain their levels of vulnerability to crime and perceived safety.

Another issue that is underrepresented in the book is sexual harassment at subway stations, trains but also on the way to these transport nodes. As suggested by Loukaitou-Sideris (2009a,b), this is an important issue because sexual harassment (groping, sexual comments addressed to women passengers, etc.) is generally quite invisible to the police and policy makers but it affects women passengers and their perceived safety.

Transportation nodes as homes: the needs of the homeless

Little is known about the movement patterns and perceptions of safety of homeless persons in Stockholm. This group is particularly interesting since they express poor perceived safety at the same time that they are, at least by some, pointed out as triggers of fear in public spaces. There is a need to better understand how the homeless shape their own fears and the fears of others around them. What are the struggles of living without a home in a city like Stockholm, where long, cold winters impose daily challenges? If individuals do not have a place to live or stay during the day, where do they their spend time? What is it like to be homeless in a city where most private properties are hermetic environments (locked or fenced off) and even open public spaces, such as subway stations, impose constraints of use? What are the *hidden rules* of the use of public spaces? More knowledge is needed to better allocate resources from national to local levels to plans and actions that deal with groups that spend most of their time in public spaces. Regardless of which actor is in charge of making decisions, one should strive to work towards practices that are inclusive and fair and, as much as possible, within participatory frameworks.

The governance of moving safely

Safety and mobility with a whole journey approach require an understating of the barriers that lead to poor cooperation between actors within and across sectors and organizational scales. They demand more than a *quick fix* of the physical environment at transportation nodes. The quality of the coordination between actors (police, municipalities, crime prevention councils, NGOs, and private citizens) would be worth investigation. The role of municipalities is fundamental here since they are responsible for day-to-day spatial planning decisions ranging from designing a new residential area or subway station to placing and maintaining physical infrastructure (e.g. streets and sidewalks) – all of high relevance for individuals' safety and accessibility to public transportation. Municipalities also influence decision-making power of district groups, police, developers, businesses/companies, and other actors in the political process. At same time, achieving cooperation in itself should not the main goal of getting together. Partnership should be a means to support different actors to solve safety problems at transportation nodes, not the end.

Some barriers between actors are administrative (including geographic and/or organizational), while others are related to the divide of public-private actors and their areas of power. There are barriers in the Swedish legislation too, for instance to share information between authorities. Fewer legal barriers (particularly data secrecy and information sharing) between local authorities would allow early intervention by those initiatives that work with youngsters at risk. Moreover, the lack of clarity about *who is responsible for what* around subway stations could be used as a concrete case in future studies. A hypothesis to be tested is: Poor coop-

eration of actors dealing with safety in transportation nodes affects negatively criminogenic conditions and perceived safety of these areas.

Research in this area constitutes a united but multidisciplinary research field, which, in practice, has been developed by distinct types of professionals who do not always follow the same theoretical principles (e.g. criminologists, planners, sociologists, transportation engineers, psychologists, geographers, etc). This seems to be a natural development since some problems better fit certain types of professionals, but this also imposes a price in terms of advancement and acceptance of methods. Reality demands more integrated, holistic, and cross-disciplinary theories, as well as methods that are capable of guiding (and dealing with) an ever-increasing volume of space and time data – which constitutes the new frontier of research in urban safety and planning practices. Thus, the posed research questions also demand a broader perspective to crime and perceived safety in urban environments. Adopting *a whole journey approach* means that safety cannot be an issue dealt by a research area alone. For planners, the challenge is to consider station's as part of local city contexts (as node-places) at the same time that the field has to be sensitive to the needs of different groups of users, who has different needs, vulnerabilities to crime and express different levels of perceived safety. For environmental criminologists, the challenges lie on the need of more research on the effect of environment on crime causation and on individual's perceived safety over space and time.

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Definitions

Aggression theory – suggests that weather, and particularly temperature, heightens physiological arousal at certain times and leads to aggressive thoughts and, in certain cases, violence.

Assault – a person who inflicts bodily injury, illness, or pain upon another or renders him or her powerless or in a similar helpless state, shall be sentenced for assault (The Ministry of Justice 1999). This book focuses on cases of assaults, rather than on those who commit this violent crime.

Awareness space – in environmental criminology, it refers to criminals' knowledge about the environment and its opportunities for crime, which depends on their routine activity (see Brantingham and Brantingham 1984).

***Basområde* –** are statistical units used to account for annual data (demographic, socio-economic, housing, and land use data). They can be similar to the U.K.'s Output Areas, and, in Stockholm, are on the geographic level under Parishes.

Built Environment – encompasses urban design, land use, and the transportation system (Handy et al. 2002). It can be micro-scale (such as type of entrance, stairs, facades, sidewalks, street crossings, lighting) or community-level factors known as macro-scale elements in surrounding areas (e.g. parks, industry, shopping centers).

CBD – The Central Business District is commonly described in the literature as the central district of a city, usually typified by a concentration of retail and office buildings.

Customer service hosts (*värdar***) -** provides a human face to the basic transportation service and increases traveler safety. These customer service hosts move across the network and work closely with other personnel (ticket controllers, drivers, and traffic management).

Crime Prevention Through Environmental Design (CPTED) – is a multidisciplinary approach to deterring criminal behavior through environmental design (Wikipedia 2013a).

Crime – is fundamentally defined as *an antisocial act that violates a law and for which a punishment can be imposed by the state or in the state's name* (UNHSP 2007: 50)

Crime attractors – the mixed land use around a station may be a typical crime attractor, or a place affording many criminal opportunities that are well known to offenders. Criminally motivated people are drawn to such locales, thus increasing the number of crime and disorder events (see Brantingham and Brantingham 1995).

Crime generators – are places to which large numbers of people are attracted for reasons unrelated to criminal motivation. Providing large numbers of opportunities for offenders and targets to come together in space and time produces crime or disorder (see Brantingham and Brantingham 1995).

Dagbefolkning – the employed population in a particular geographical unit.

Defensible space – a theory developed by the architect Oscar Newman (1972) based on the interaction between individuals and their environment. Newman stated, for instance, that the type of building influences what occurs on the streets surrounding it; that the housing design can actually make individuals feel safe. A fundamental concept of this theory is that of natural surveillance: the *capacity of physical design to provide surveillance opportunities for residents and their agents* (Newman 1972:78).

e-Adept (Electronic Assistance for Disabled and Elderly Pedestrians and Travelers) – a navigation system for visually impaired and elderly individuals built with the support of Stockholm municipality, funding organizations, and private companies. *e-Adept* utilizes information from road, bicycle, and pedestrian networks together with municipal databases to provide instructions according to different user profiles, including pedestrian guidance along sidewalks, park paths, and other walkways. By entering the origin and destination addresses, the user is provided with directions and detailed information about the environment. Information can also be retrieved about public transportation services so that the user can get a pedestrian route to a departure bus stop and information about line numbers and where to disembark. When the individual gets off the bus, the system continues to provide pedestrian guidance to the target address. There is an alarm function that makes it possible for the individual to rapidly get in touch with a relative, friend, or emergency services.

Fear of crime – refers to the fear of being a victim of crime as opposed to the actual probability of being a victim of crime (Hale 1996; Farrall et al. 2007). Fear of crime includes *a variety of emotional states, attitudes, or perceptions* (Warr 2000: 453).

Gender-informed approach – is defined by actions that intend to foster gender awareness, knowledge, and competence among both women and men as citizens, encouraging them to claim equal enjoyment of rights and benefits of safe urban

environments; in this particular case, stations. A gender-informed approach to safety is legitimized because women and men use space differently, perceive risks differently, and also show different spatial patterns of victimization.

Geographical Information Systems (GIS) – is designed to capture, store, display, communicate, transform, analyze, and archive geo-referenced information, that is, information tied to specific locations on the Earth's surface. Geographic information systems enhance and to some extent replace the traditional role played by maps, but are also capable of handling information in the form of satellite images of the Earth's surface, as well as information from surveys and administrative records that have been geo-referenced. They are increasingly used in the social sciences to support research based on cross-sectional data, or studies for which geographic location and context are important and useful (Goodchild 1985).

Housing instability – an area characterized by housing instability shows a negative value (more residents leaving the area than moving in) of net population which, in this book, is indicated by the net difference between residents moving in geographical areas and those moving out in a particular year.

Kulldorff's scan test – is a clustering technique available in SaTScan™, which is a free software that analyzes spatial, temporal, and space-time data using the spatial, temporal, or space-time scan statistics (see , Kulldorff, 1997).

MTR Stockholm - MTR Stockholm (MTRS) has the responsibility for the running, planning and maintenance of the Stockholm underground system. MTR Stockholm is a subsidiary of MTR Europe in London, and employs about 3,000 people. Since autumn 2009 and for a minimum of eight years.

Mobility disability – results when a person is not able to move or navigate in their environment. It can result from impairments and/or activity restrictions (Patla and Shumway 1999).

Natural surveillance – is the *capacity of physical design to provide surveillance opportunities for residents and their agents* (Newman 1972:78).

Off-peak hours – are hours in between peak or rush hours.

Peak hours – also called rush hours. In this book, daily peak hours are early morning, early afternoon, or early evening (e.g. 8:00-9:00 am; 12:00-13:00 pm; 17:00-18:00 pm).

Pickpocketing – is a form of theft that involves the stealing of money or other valuables from the victim without their noticing the theft at the time (Wikipedia 2013b).

Property crimes – in this book, it refers to theft, robbery, and burglary.

Public transportation – is a shared passenger transportation service that is available for use by the general public, as distinct from modes such as taxicabs, car pools, or hired buses, which are not shared by strangers without private arrangement... *Public transportation services are usually funded by government subsidies and fares charged to each passenger. Services are normally regulated and possibly subsidized from local or national tax revenue* (Wikipedia 2011c).

Public disorder – a person who is noisy in a public place, or who otherwise publicly behaves in a manner apt to arouse public indignation, shall be sentenced for disorderly conduct (The Ministry of Justice 1999). In this book, it could be disturbing events to passengers at the station, such as inappropriate use of a water hose on platforms or public urination in elevators, etc.

Rational choice theory – in Criminology, it assumes that a criminal thinks about its decisions before committing crime. The likelihood of escaping without being detected, and the chances of being seen are assessed by the potential offender before she or he decide to commit an offence. From offenders' points of view, an subway station as a building with its all auxiliary features can provide a proper environment for committing crime. The presence of hiding places, dark corners, insufficient illumination, and lack of formal and informal social control may contribute to offenders' decision to commit an offence.

Robbery – according to the Swedish penal code, *a person who unlawfully takes what belongs to another with intent to acquire it* (The Ministry of Justice 1999). Robbery differs from theft as robbery implies violence when the offender meets the victim, sometimes through the use of weapons. Although in pick pocketing, for instance, the offender is also in contact with the victim, the victim is not aware that he or she has been victimized at the exact moment that the crime takes place. In practice, however, real life events make difficult to untangle differences between pick pocketing and robbery.

Routine activity theory - is a sub-field of crime opportunity theory, developed by Marcus Felson and Lawrence Cohen who suggest that three necessary conditions for most crime; a likely offender, a suitable target, and the absence of a capable guardian, coming together in space and time.

Safety/security – safety (used here as synonym of security) as a concept is complex and problematic; its use makes sense only when it is attached to a context or a specific discipline (Ceccato 2012a). In this book, the definition of it is limited to crime and fear of crime. Nevertheless, safety is also a social construct; produced and reproduced by individuals' actions and interventions in everyday life.

Situational crime prevention – is a place centered approach. It is focused on actions towards reducing the opportunities for criminals to commit crime; it changes criminals' ideas about whether they can get away with a particular crime and makes it seem riskier, and less rewarding to commit crime (For more details, see e.g. Clarke 1980; Cornish and Clarke 1986; Clarke 1995).

Situational action theory – postulates that crime is the result of the interaction between individuals' crime propensity and their exposure to criminogenic environments (Wikström 2005).

Shoplifting – is theft of goods from a retail establishment (Wikipedia 2013d).

SL (Storstockholms Lokaltrafik) – Stockholm Public Transport (Company) – All traffic is run by companies that have competed for contracts under SL. SL is responsible for the overall plan, commission, and follow up of services, while the transportation contractors are responsible for detailed planning, service delivery, and customer interaction. SL also bears responsibility for much of the public transportation infrastructure (SL 2013).

Social control – loosely defined, social controls are composed of mechanisms that regulate individual and group behavior, leading to compliance to the rules of a given place or group. They can be informal or formal. According to Conklin (2007), informal social control, or the reactions of individuals and groups that bring about conformity to norms and laws, includes peer and community pressure, bystander intervention in a crime, and collective responses such as citizen patrol groups. Formal social control is, according to Poore (2007), expressed through laws such as statutes, rules, and regulations against deviant behavior, and is imposed by government and organizations using law enforcement mechanisms and other formal sanctions such as fines and imprisonment. These concepts provide the basis for social control theory (for details see, e.g. Hirschi 1969). In this book, the use of devices to maximize control over environments and individuals is regarded as an extension of mechanisms of social control through, for instance, CCTV cameras.

Social disorganization theory – was first developed in the studies of urban crime and delinquency by sociologists at the University of Chicago and the Institute for Juvenile Research in Chicago in the 1920s and 1930s. The theory is based on the idea that crime occurs when the mechanisms of social control are weakened. Social disorganization theory pioneers Shaw and McKay (1942) suggested that disorganized communities are characterized by poverty, ethnic heterogeneity, and residential mobility which lead to poor social control and crime. Developments of the theory occurred since the pioneering studies of Shaw and McKay, especially by Kornhauser (1978) and Sampson et al. (1997).

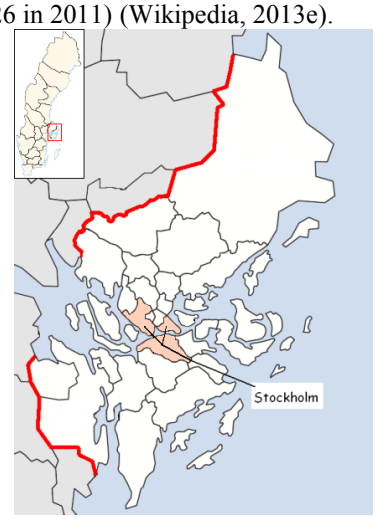
Social Environment – social relationships within which defined groups of people function and interact (McNeill et al. 2006). In transportation settings, a wide range of social interactions may occur (between friends, acquaintances, and/or strangers) that direct or indirectly affect safety. They can be *passive*, such as standing at a platform and waiting for the train to arrive, or *active*, such as chatting with another passenger, helping am elderly person enter the train, or damaging benches (anti-social behavior).

Stations' immediate vicinity – a limited area around the station. In this book, it is limited to an individual's field of view from the entrance of a subway station.

Stations' surroundings – in this book, comprehend an area larger than the subway stations' immediate vicinity; sometimes it is used as synonym as the neighborhood context.

Stations' city context – in this book, it refers to the location of the subway station in the urban area, for instance, inner-city or periphery, North or South, in the main land or in an island.

Stockholms stad – The municipality of Stockholm and is the capital of Sweden, with a population of 871,952 in 2011, and part of the Greater Stockholm area (population of 2,084,526 in 2011) (Wikipedia, 2013e).



Stockholm city, Stockholm county, and Sweden.
Source: http://en.wikipedia.org/wiki/Stockholm_Municipality

Structured activities – Activities that follow daily and weekly patterns, such as being in class at school and/or being at work.

Systembolaget – Alcohol stores owned by the Swedish state. The Swedish government has a monopoly on selling alcoholic beverages containing over 3.5 percent (by volume) alcohol.

***T-Centralen* or Central Station –** is composed of *T-Centralen* subway station, railway and bus platforms. This transportation node is the largest in Sweden, with over 200,000 visitors daily.

Theft – The result of *a person who unlawfully takes what belongs to another with intent to acquire it, shall, if the appropriation involves loss, be sentenced for theft* (The Ministry of Justice 1999).

***Trafikverket* -** The Swedish Transport Administration is responsible for the construction, operation and maintenance of all state owned roads and railways.

Transportation nodes – are places where people come together to (dis)embark on a trip in order to reach a destination. Transportation nodes can be bus stops, subway stations, or larger structures where several transportation modes come together, such as a central station or a transportation hub. Transportation nodes include the station itself but also its immediately surrounding environments (Ceccato 2010).

Unstructured activities – Activities that happen before or after structured activities, such as leisure activities. They are called unstructured since they may not follow a pattern regarding when, where, or with whom they occur. Spending time with friends at a bar's 'happy-hour' or hanging around at a friend's home after school are typical examples of unstructured activities.

Violent crimes – in this book, this refers to assault, threats, and fights of different types.

Vandalism – in this book, these are events of physical damage, such as breaking lights or any other feature of the station, including marking the walls with graffiti.

Appendices

Appendix 6.1 – Template used in the stakeholder interviews

1. Jag ska börja med några grundläggande frågor. Vad sysslar MTR med? Vad sysslar du med? Är MTR ansvarig bara för T-banan?
2. Kan du definiera MTRs jobb med säkerhet och trygghet? Vad är säkerhet/trygghet för MTR?
3. Om du tänker på MTRs budget, hur stor är andel av MTRs pengar ägnas åt detta?
4. När man tänker på säkerhet och trygghet på tunnelbanan idag, vad satsar MTR mest på? Vänligen dela upp 100 poäng på de följande alternativen:

_____Vakter, poliser
_____Miljömässiga designaspekter strategier för att skydda olika delar av systemet, övervaka, eller öka tryggheten och trivseln hos passagerarna (CCTV, belysning)
_____Offentlig utbildning / användaruppsökande (outreach)
_____Social brottsprevention i skolor, Grannskapssamverkan, osv
_____Annat, Vad?

5. Stockholm har tre tunnelbanalinjer. Hur gör MTR för att anpassa verksamheter till de olika linjernas problematik vad gäller säkerhet och trygghet? Har ni olika sätt att arbeta med trygghet på de olika linjerna eller kanske mellan olika stationer? Isf vad?
6. Jag undrar hur ni följer upp de olika säkerhet-/trygghetssatsningarna?
7. MTR Stockholm har genomfört ett antal cafékvällar på olika tunnelbanestationer under året. Vad har ni uppnått med denna initiativ? Tänker ni fortsätta med det? Hur har programmet sett ut och vad är syftet med de olika aktiviteterna?
8. Om man tänker på risken för brott på tunnelbanan, vilka är de största utmaningar för MTRs dagliga arbete? Vänligen ange tre utmaningar.
9. Om man tänker på trygghet, vilka är de största utmaningar för MTRs dagliga arbete? Vänligen ange tre utmaningar.
10. Man pratar mycket om hur viktigt är att ha en *whole journey approach* eller helhetsperspektiv på resan för att undvika till exempel otrygghet på väg till och från tunnelbanan. Detta krävs ett samarbete mellan de olika transportaktörerna (Järnhusen, Trafikverket) och också med andra samhällsaktörer. Finns det något samarbete idag? Kan du ange några exempel?
11. Jag undrar hur du upplever samarbetet mellan MTR och de olika lokala och regionala aktörer (vad är det som funkar, vilka hinder upplever du). Är det regelverket? Kulturella barriärer? Ekonomiska hinder? Vänligen ange 3 positiva och 3 negativa aspekter.
12. Jag undrar om du kan peka ut tre saker som skulle kunna förbättras/hända för att möjliggöra ett bättre samarbete (inom säkerhet/trygghet) bland de lokala, regionala och nationella aktörerna?
13. Man prata mycket om trygghet åt alla. Särkilt i de statliga planerna och Stockholmsöverenskommelsen. Jag undrar om MTR tycker att det finns vissa grupper som har tydliga säkerhetsbehovom MTR har sådana program på plats för:

Äldre och Funktionshindrade

Kvinnor – otrygghet bland dem är alltid större än bland män. Har ni någon speciell handlingsplan för det? Vad gör ni för att ta itu med kvinnors säkerhetsbehov?

Hemlösa/Missbrukare

14. Kollektivtrafik är en allmän nyttighet. Hur ser du på rollen av privata aktörer (som MTR) som en leverantör av en så viktig service i samhället?

Appendix 7.1 - Selected offences and corresponding codes from the 2008 Swedish police records.

Offences	Offence code
Robbery	855-856, 864-867, 870-873, 892, 896, 9806, 9808, 9810, 9812
Burglary	857, 874, 9801, 9802
Theft	801-854, 858-861, 876, 880, 883-888, 9803-9804
Criminal damage	1201-1209
Threat	404-414, 422-429, 501, 1604-1605, 1705
Drugs/Alcohol-related	5001-5011, 5040-5045
Violence (Outdoors)	303-313, 355-358, 375-378, 1301, 6001, 1701-1704, 9301-9304, 9309-9312, 9317-9320, 9325-9328, 9333-9336,9341-9344, 9350-9353
Other (e.g. urination)	607, 1304, 1602-1603, 4013, 9001

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About the Author

Vania Ceccato is Associate Professor with focus on Urban Safety at School of Architecture and the Built Environment, Royal Institute of Technology (KTH) in Stockholm, Sweden. Her research interests are the geography of crime, safety and gender, quantitative methods and spatial data analysis. She has conducted research on spatial patterns of crime in Scandinavia, Brazil, UK and the Baltic countries of Estonia, Latvia and Lithuania, particularly on the relation between crime and socio-economic neighborhood dynamics and land use characteristics. Her current research projects deal with transit crime, crime and housing market, safety in rural areas, space-time variations of crime and people's routine activity, women's mobility and nature of rape places. She has published in international journals, mostly in Criminology, Geography and Urban planning. She is the editor of the book "*The urban fabric of crime and fear*" published by Springer in 2012.