交通环境犯罪：从瑞典斯德哥尔摩和巴西圣保罗地铁系统的经验总结

Crime in transit environments: Lessons from Stockholm (Sweden) and São Paulo (Brazil) metro systems

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摘要：笔者通过评估瑞典斯德哥尔摩和巴西圣保罗地铁系统的犯罪活动及扰乱公共秩序行为案例，探讨相关经验教训。对比 2 个国家地铁系统的时空犯罪模式及上述案例的研究结果，总结环境对犯罪活动及扰乱公共秩序行为的影响。研究中地理信息系统、田野调查和建模等分析过程应用了相应地铁运营商的基础数据。研究发现市中心地铁站及终点站往往比其他站点更容易发生犯罪。除了区位因素，地铁站的环境属性、周边环境及社区环境也会影响站点的犯罪机会。预防犯罪的干预措施必须针对具体犯罪活动、核心地铁站的拥挤情况，特别是易发生犯罪的高峰时段制定。以此总结今后相关研究方向，并提出相应政策建议。
关键词：犯罪；地铁；物理和社会环境；地理信息系统；斯德哥尔摩；圣保罗

Abstract: In this article, we discuss lessons learned from assessing crime and public disorder in two major metro systems: Stockholm (Sweden) and São Paulo (Brazil). We compare temporal and spatial patterns of crime in these metro systems in two national contexts, then we compare findings from these two case studies to reason about the influence of the environment on crime and public disorder. Data from the respective transportation companies are used as the basis for the analysis, which involves Geographical Information Systems (GIS), fieldwork and modelling. Inner city metro stations but also end stations tend to concentrate more crime than stations in any other parts of the city. More than location in the city, results show that opportunities for crime at the stations are dependent on the stations' environmental attributes, surroundings, and neighbourhood context. Crime prevention interventions must be crime specific and tackle crowded conditions at core stations especially at rush hours since they facilitate crime. The article concludes with directions for future research and suggestions for policy.
Keywords: crime; metro; physical and social environment; GIS; Stockholm; São Paulo

机动性是当代城市高效运作与可持续发展的基本要求。尽管交通环境目前仍存在由犯罪和恐怖主义威胁等造成的安全问题，但公共交通仍是城市实现经济繁荣和可持续交通的关键。详细了解安全环境的基本特征，对于城市公共交通可持续性，尤其是地铁系统可持续性的深入讨论至关重要。既往研究很少涉及地铁站设计与发生犯罪活动及扰乱公共秩序行为概率的关系。切卡托等 [1] 利用地铁站的整合数据将关注点聚焦于站点的犯罪案件，使我们留下了不同时空下城市整体风险的简单印象。地铁站及其出入口等附属部分的环境设计会影响“监视”（surveillance）作用及犯罪机会。这意味着地铁站的事件发生不仅取决于其物理环境，也受个体在交通节点移动时的人类活动影响。

笔者通过评估瑞典斯德哥尔摩和巴西圣保罗地铁系统的犯罪活动及扰乱公共秩序行为案例，探讨相关经验教训。对比 2 个国家的地铁系统的时空犯罪模式及上述案例的研究结果，结合切卡托提出的概念性理论框架 [2]，总结环境对犯罪活动及扰乱公共秩序行为的影响。这是至关重要的，因为预防地铁犯罪的方法是防范于未然，其关键是确定特定时空下特定犯罪类型的潜在驱动因素。情景犯罪预防策略强调减少犯罪机会，即通过改变环境及其管理方式，从而预防犯罪的发生 [3]。

笔者总结并借鉴切卡托及其同事在瑞典、巴西等国的研究工作 [2, 4-7]，探讨了分析模型的理论原理，构思 2 个案例研究并描述其研究方法与结果，最后强调犯罪水平及犯罪模式在 2 种交通环境中的共性和差异。

1 理论背景

1.1 犯罪的时间模式

犯罪机会的时空分布既不是均匀的，也不是随机的[8]，但的确是遵循人类活动规律分布的。犯罪的时间分布与人们的日常活动有关。地铁站每天都会聚集大量人流。日常活动理论[9]认为个体活动与日常习惯是有规律的，且其活动模式不断重复。大多数犯罪活动取决于空间和时间的相互作用：犯罪者的动机、合适的目标、缺乏有能力的监察人。由于在特定时间地铁站是人群聚集的地方，至少是在特定时段[1]容易成为犯罪地[10]。日常活动理论认为个体在户外活动上所花的时间越多，越有可能创造更多犯罪机会。因此，交通节点等“犯罪吸引体”（crime attractors）时刻都在为犯罪行为的发生提供机会。既往研究早已证实犯罪行为随着月份和季节而波动，但其模式取决于具体的犯罪类型[11]。

1.2 地铁站犯罪的空间模式

地铁站犯罪（及扰乱公共秩序行为）受站点的物理和社会环境特征、当下环境和社区环境特征、站点和社区在城市中的相对位置所影响。这一概念模型依赖于环境犯罪学、情境犯罪预防、环境设计预防犯罪（CPTED）理论[2]。

1.2.1 地铁站的物理和社会特征

地铁站点对犯罪活动的脆弱性取决于其物理环境及特定环境下发生的社交类型。物理环境是指车站的硬件设施，包括所有肉眼可见的东西。地铁站点可能会因尺度（例如，交通枢纽站点往往较大）、类型（例如，市中心地铁站通常是地下的，而偏远的站点通常建在地上）或样式（例如，现代的透明墙）而有所差异，但仍然遵循一些基本标准。

地铁站包括出入口区域（如隧道，楼梯，电梯，商店和餐厅），站厅（如售票亭，自动闸机和商铺），过渡区域（如楼梯和电梯）和站台（如单站台和多站台），并通过周围环境（如街道和停车场）与城市相连。不管布局如何，地铁站通常由站台、过渡区域、站厅、出入口区域和周围环境5部分组成：站台即列车到达、乘客进出车厢、候车的区域；过渡区域通常由连接站厅和站台的楼梯和电梯组成；站厅一般包括自动闸机和售票亭组成的开放区域，并连接出入口；站厅和出入口区域一般都设有商铺；出入口区域是直接从街道、门口、楼梯或隧道进入站厅的区域；周围环境是从地铁站出入口直接看到的，离出入口只有几米距离的区域。皮萨和肯尼迪认为进出地铁站的便捷性及乘客对站点的不熟悉，导致犯罪机会的增加[12]。长期研究表明站点（和公交站）的照明、设计、区位和安全硬件等物理特征可减少犯罪机会[6-7, 13-16]。

1.2.2 地铁站和社区环境

地铁站安全受社区环境影响的因素有2种：1）周围地区的土地利用类型及其吸引的社会活动；2）该社区居住或工作的人口和社会经济特征。肖和麦凯[17]最早在芝加哥开展邻里条件和犯罪的关系研究，其成果后来成为社会解体论的主要参考。社会解体论将多种犯罪类型和非正式的社会弱控制力联系起来，并认为犯罪的发生与其区位无关。因此，一般来说，社会控制力低下的贫困地区犯罪率较高，这些地区的地铁站犯罪率也较高[2]。但也有例外，如拉维尼指出华盛顿地铁站犯罪率与站点所在的人口普查区犯罪率无关[14]。

1.2.3 城市环境中的地铁站

地铁站规划通常都是尽可能地容纳更大的客流承载量，站点的设置往往位于住宅区、工作地点、工业区或商业中心的步行距离内。交通节点的这种中心性易导致犯罪。不同土地利用类型会影响该区域的社交活动，进而影响犯罪的空间分布。环境犯罪学已表明市中心比城市其他地区更易引起犯罪[7, 18-21]。因此，可以推断出市中心地铁站比起市郊地铁站更易导致犯罪活动和扰乱公共秩序行为的发生。或者，地铁终点站由于经常连接大客流的交通节点，或与犯罪较频发的停车场和商业区相连，比沿线其他中途站更易导致犯罪。

2 案例研究

2.1 两个地铁系统

2.1.1 斯德哥尔摩地铁系统

斯德哥尔摩地铁由100个连接着巴士和通勤列车的车站组成，其中47个地下车站（大多位于市中心），53个地上车站，共3条地铁线路：红线、绿线和蓝线（图1-1）。本研究将报告整个斯德哥尔摩地铁系统中的犯罪活动和扰乱公共秩序行为事件，但由于数据限制在建模阶段仅使用位于斯德哥尔摩市区的82个车站数据。斯德哥尔摩位于瑞典的东南岸，市区在群岛上蔓延，因此水占据了大部分城市景观。这些岛屿通过公路和高效的公共交通系统（包括公共汽车、地铁、铁路系统和通勤列车）连接起来；斯德哥尔摩由于地处北欧，寒冷黑暗的冬季限制市民的户外生活，春夏季却有相当长的白天时间。2016年斯德哥尔摩居民人口为910 000，它是瑞典的首都、人口最多的城市，也是斯堪的纳维亚地区人口最多的城市。

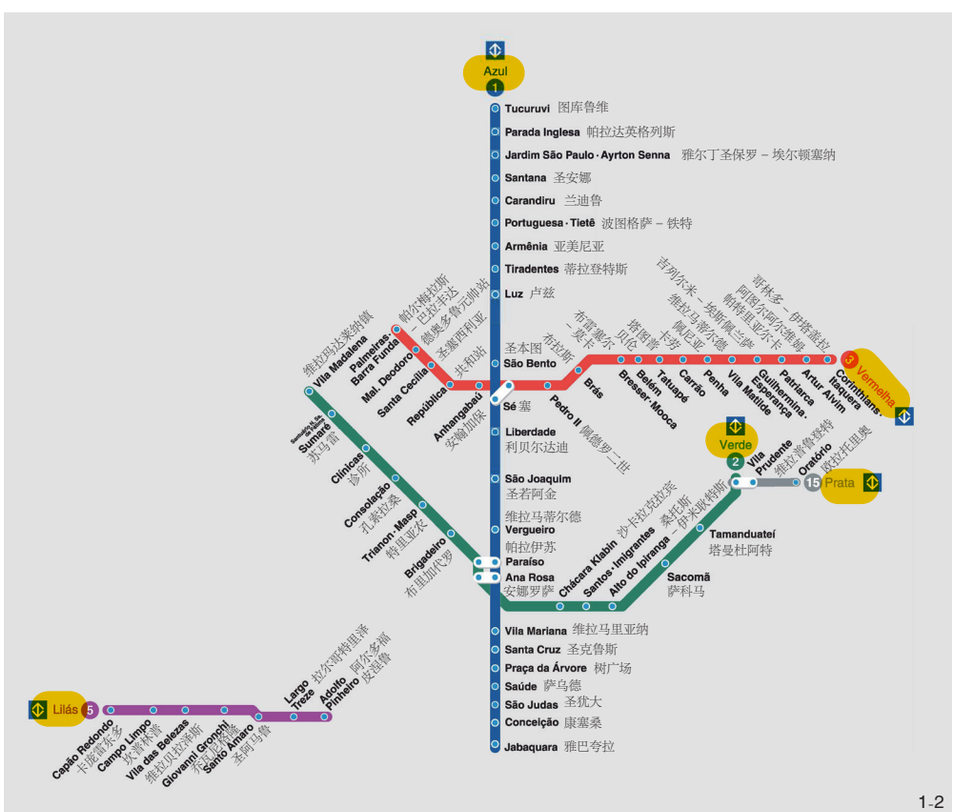
2.1.2 圣保罗地铁系统

圣保罗地铁（大都会圣保罗）的研究对象共62个车站，不包括一些扩建车站（共65个车站），是圣保罗市主要的、巴西规模最大、南美洲第二规模的快速交通系统（图1-2）。圣保罗于1968年兴建第一条地铁线，而今已有五条地铁线路（74km，图1-2），每天154辆列车从4 ： 40运行到24 ： 00（周六运营至次日1 ： 00），日载客量高达4 600 000。地铁在拥有1 200万人口的圣保罗市内运行，市内也有一些公司提供通勤列车服务。圣保罗是巴西最大的城市、南美洲最大的大都市区，同时也是巴西、西半球及南半球人口最多的城市。

2.2 数据和方法

斯德哥尔摩地铁的犯罪活动及扰乱公共秩序行为案件的数据通过斯德哥尔摩公共交通部（2006—2009年）和警方的统计数据（本研究不讨论警方数据）获取。研究根据每个站点客流量计算出每1 000名乘客的犯罪率，而不是直接使用犯罪案件的原始数据。通过将现场调研（清单）的数据输入到电子表格，并将其与土地利用、犯罪数据、人口统计数据、社会经济数据等导入到地理信息系统（GIS），其中地铁站点及犯罪数据被设置为点数据（point data），斯德哥尔摩人口统计和社会经济数据与小单元统计数据（small unit statistics）相关联。为了评估周围环境对每个站点的犯罪活动及扰乱公共秩序行为案件的影响，人工绘制了一些容易引发犯罪的土地利用类型的位置：ATM机、学校、警察局、

1-1



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1-1 斯德哥尔摩地铁线路图
Stockholm metro map
1-2 圣保罗地铁系统
São Paulo metro map

州立酒精销售点。研究是基于全面的田野调查与地理信息系统的技术与建模[2]。

圣保罗地铁的犯罪数据主要来自São地铁运营商(按类型和站点汇总,2013—2015年),利用大都会警察局和民警(乘客2010—2015年报告的案件)的数据,以及短信服务(2014—2015年),该服务用于举报乘坐地铁期间发生的犯罪和其他事故。犯罪案件包括财产犯罪和暴力犯罪,如盗窃,抢劫和各种暴力行为(包括性侵及性骚扰)。为了案例数据的统一,乘客人数同样通过地铁运营商获取,包括站点工作日高峰和非高峰时段的乘客人数,以及工作人员总数(安保和总体)。研究将地理信息系统(GIS)与通过谷歌街景、其他二手数据收集的犯罪记录整合成回归模型[5]。

3 结果

3.1 犯罪和扰乱公共秩序罪的性质

由于记录方式的差异显著影响地铁系统的犯罪及扰乱公共秩序罪案件的水平,因此难以对不同地铁系统的犯罪数据进行对比。犯罪案件的具体数量也因数据来源而异,例如,斯德哥尔摩官方警察统计数据中的财产犯罪比斯德哥尔摩公共交通公司记录的要多。下文从两个公共交通公司提供的数据库讨论一些主要趋势,但严格来说,由于记录方式和数据收集时间的不同,对比数据时应谨慎比较。

总的来说,地铁站的大多数事件(不一定是犯罪)都会影响乘客的安全感。较常见的违法行为是对旅客和工作人员的威胁恐吓和人身攻击,其中斯德哥尔摩地铁的违法记录比圣保罗更多一些。财产犯罪在圣保罗地铁系统违法行为中占了最大的比例,可以分成2种:对人和对物。后者包括车厢和车站内的盗窃行为(如手机盗窃相对来说在圣保罗更常见)、在商店和食品店偷窃、以及在地铁站周边(停车场或街道)较常见的单车和汽车偷窃。

在圣保罗地铁系统中,62%的案件是盗窃和抢劫等财产犯罪,打架斗殴及其他暴力犯罪约占20%,性侵犯及性骚扰也被记录了[5]。值得注意的是,这个数据库不包括如对财产的物理伤害、乞讨及其他扰乱公共秩序行为等犯罪类型(部分通过其他方式收集的,如短

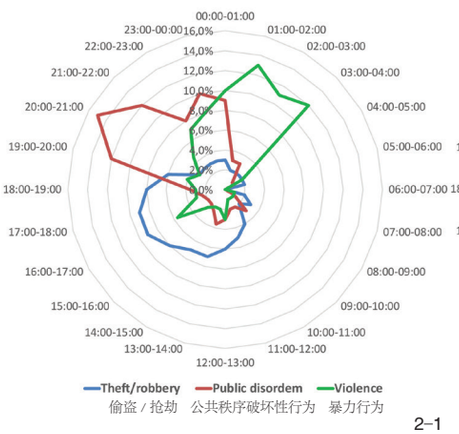
信服务）。被记录的案件是斯德哥尔摩地铁系统记录不可缺少的一部分，约占整体案件的 80%。向交通公司报告的案件中有 20% 是犯罪行为，其中多为打架斗殴（约 40%）、破坏行为及威胁，其次是其他暴力行为。暴力行为的受害者基本上都是工作人员、警卫、司机或乘客。警方抢劫数据显示有相当部分发生在地铁站，尽管大多都是发生于地铁站内的商店或超市等地点。绝大多数都是非法活动或反社会行为的社会秩序混乱案件，如随地小便、吸毒、街头滞留、公共场所酗酒、车厢或车站内的紧急刹车、灭火器或消防水带等装置的不正当使用 [2]。

3.2 犯罪和扰乱公共秩序罪的时间分布

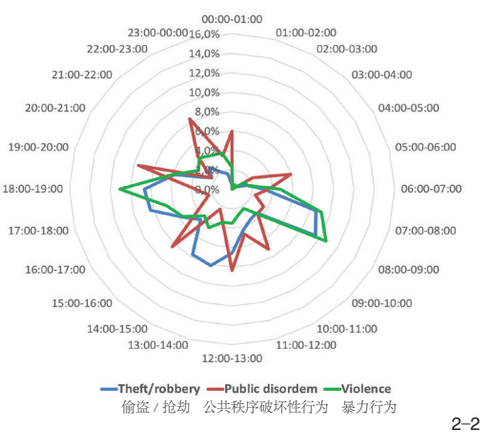
分析交通环境中犯罪的时间分布是制定有效预防犯罪措施的基础。两个地铁系统高峰时段都有暴力和盗窃行为发生，但在时间分布上不尽相同。圣保罗地铁的暴力和盗窃行为大多发生在早晨和傍晚(早晨 8 ： 00—9 ： 00 左右及傍晚 6 ： 00—7 ： 00），而斯德哥尔摩地铁犯罪行为的高峰时段随犯罪类型而异：盗窃行为在下午 2 ： 00—7 ： 00 间达到峰值，而暴力行为往往发生于午夜后（图 2）。

斯德哥尔摩地铁周末和节假日的违法行为比工作日要多得多，这可能是因为周末和节假日时人们经常参加如派对、喝酒等更容易吸引犯罪的“随机活动”，而工作日时其日常活动大多为“固定活动”[13]。圣保罗地铁的犯罪案件数量因犯罪类型而异，但总体是遵循每天上下学、上下班等日常活动的固定模式。例如，性侵犯或性骚扰大多发生于工作日上下班途中(周一和周二占 20%，而周六仅 6%），其峰值在早晨 8 ： 00—9 ： 00 及傍晚 6 ： 00—7 ： 00 的高峰期 [5]，这期间大多数车厢和线路都拥挤不堪。

尽管圣保罗地铁犯罪案件的季节性变化需要更长的时间来测得，但结果表明巴西冬季 6、7 月的案件数量略有增加。斯德哥尔摩地铁暴力犯罪（如抢劫、打架斗殴、威胁）也呈季节性变化，且集中于瑞典温度较高的月份（表 1）[22]。值得注意的是 2 个城市的地理环境截然不同：瑞典斯德哥尔摩位于斯堪的纳维亚半岛，冬季漫长且黑夜时间长；而圣保罗位于年平均气温达 21℃的热带国家巴西。这些气候差异必然会对人们的日常活动的行为模式有影响，进而影响其交通环境的犯罪水平。



2-1



2-2

2 不同犯罪类型的时间分布情况 （按每小时计）
Distribution of crime by hour of the day (counts per hour)

2-1 瑞典斯德哥尔摩
Stockholm, Sweden
2-1 巴西圣保罗
São Paulo, Brazil

3.3 犯罪和扰乱公共秩序罪的空间分布

上述 2 个城市的地铁系统都表明市中心站点犯罪案件数量较多，但如果依据每个站点日客流量来计算犯罪活动及扰乱公共秩序行为的比率却有不一样的结果。研究利用不同犯罪类型的数量与每 1 000 位乘客的比率得出相应犯罪率，而不是直接使用原始数据，获得了更加有趣的犯罪空间分布。结果表明，地铁线路终点站比起市中心的站点更容易引起犯罪（Medborgarplasten 站和 Skanstull 站的盗窃类型除外）。更有趣的是，Hjulsta，Farsta Strand，Hässelby，Vällingby 和 Hagsätra 等地铁站（均为外围站点）在各种犯罪类型上都显示较高的比例，这一点对预防犯罪措施的制定非常有用。圣保罗地铁站的犯罪空间模式也是相似的，但各种犯罪类型都比较集中在市中心地铁站。市中心 3km 范围内的地铁站犯罪率较高，且犯罪率以市中心（例如 Paraíso 站和 Liberdade 站）的 Sé 车站为中心发生距离衰减分布。区域交通枢纽站在以日客流量为基准计算犯罪率后也表现出较高的犯罪率（例如 Brás 站，Palmeiras-Barra Funda 站，Tatuapé 站）。

部分地铁站对特定犯罪类型有较高的聚集性。如斯德哥尔摩的林克比站、韦斯托尔托站和挪威站分别存在较多的暴力、偷窃、破坏行为。其中部分地铁站位于高犯罪率地区，这些地区往往属于混合土地使用地区、靠近商业区、或是人流聚集的终点站。圣保罗的犯罪聚集性并不表现在地铁站点上，而在性骚扰这一犯罪类型上，如性暴力案件大多聚集在最繁忙的中心站点及各种犯罪滋生的站点 [5]。已有学者对上述 2 个地铁系统不同线路的犯罪案件的变化进行对比研究 [5, 23]。

表 1 不同季节的暴力犯罪情况，斯德哥尔摩，2006—2008 年
Tab. 1 Violent crimes by season, Stockholm, 2006—2008

	犯罪案件平均值	F 检验	Scheffe 多重比较法
冬季 (1)	48.19	2,901*	1.3/3.1
春季 (2)	51.90		
夏季 (3)	53.54		
秋季 (4)	51.98		

* 在 0.1 水平上有显著性差异

表 2 车站特征、社区环境及城市背景
Tab. 2 Characteristics of the stations, neighbourhood surroundings and city context

斯德哥尔摩地铁	圣保罗地铁
影响可视性、监视作用的物体	黑暗角落
角落、隐蔽的地方	监控数量、较大的车站
站台数量，较大的车站	物质环境和社会环境恶化
站点附近人数较少	外围 / 中心地铁站
外围 / 中心地铁站	邻近自行车停车场
警察局数量较少	商业区、餐厅
居民机动性	被富有的社区环绕

3.4 犯罪及扰乱公共秩序罪的水平

利用上述提到的概念模型，将 2 个地铁系统的犯罪和扰乱公共秩序罪案件进行建模，建立地铁站的物理和社会环境特征（由于数据限制，斯德哥尔摩的模型比圣保罗的详细）、周围环境特征及站点和社区在城市中的相对位置的函数。笔者探讨 2 个案例研究结果的共性，值得注意的是在得出任何结论之前，由于数据的限制，斯德哥尔摩和圣保罗地铁的建模策略稍有不同。

2 个地铁系统的结果均表明站点的环境属性、其所在的社区类型及城市背景都影响犯罪机会，但这些影响因素因地铁系统自身因素、犯罪类型及时间而有所差别。对一些独立的或与其他因素糅合的影响交通节点犯罪机制的总体特征进行了总结（表 2）。站点是否位于市中心是影响 2 个地铁系统犯罪水平最重要的因素之一，市中心往往犯罪更加集中。然而，斯德哥尔摩地铁的线路终点站也容易导致犯罪。2 个案例的另一个共性是地铁站周边土地利用的影响，特别是一些高风险的设施（如餐馆）或能阻止犯罪和扰乱公共秩序罪的设施（如警察局）。值得注意的是，由于圣保罗地铁站室内设计的相关信息有限，因此其建模受到一定影响。然而，我们发现 2 个案例研究中有一些特征反复出现，如直接影响可视性（visibility）和监视程度（surveillance）的黑暗角落。下面我们更详细地讨论每个案例研究的具体情况。

就斯德哥尔摩的犯罪活动及扰乱公共秩序行为的比率而言，监控和照明特征的变量对犯罪率有 30% 的影响，当其他正式社会控制（formal social control，100m 范围内警察局的数量）、距离市中心的距离、城市背景被添加到模型时，其犯罪率上升到了 52%。就暴力犯罪的比率而言，当地铁站周围环境的变量（如开放的入口、距离市中心的距离、人口密度）被添加到模型时，模型的拟合度几乎翻倍。这些变量对偷窃和抢劫等财产犯罪的波动也起到一定的影响 [1, 13]。

对于圣保罗总犯罪率来说，车站的室内特征及其位置因素解释了犯罪率 30% 的变化。比起暴力犯罪，市中心地铁站更容易发生盗窃和抢劫等财产犯罪。大量闭路电视和工作人员、物理和社会干扰及黑暗角落的存在更容易造成暴力犯罪。同样地，由于靠近购物中心的区域与城市网络连接良好，可达性较高但规模相对较小，且被更富裕的社区包围（可能更靠近自行车停车场或餐厅）[5]，这些站点也容易聚集暴力犯罪。

4 斯德哥尔摩和圣保罗地铁系统的经验总结

地铁车站是容易导致犯罪的地方，而且某些车站往往比其他车站更容易发生犯罪活动和扰乱公共秩序行为，且这种脆弱性会随时间而改变。地铁站的大多数犯罪都是随时间而波动的，他们往往在一天，一周或一年的特定时段更容易发生。这些时间上的波动往往和人们的日常活动有关 [24-25]。哈里斯 [26] 等对这种时间波动提出了另一种解释，他认为人们压力的表现可能存在滞后现象，压力在白天积累，随后在人们下班后去别的地方时压力外化并爆发。这些发现与既往研究有着类似的结论：人们在闲暇时间相遇时更容易发生冲突。然而，这些冲突也会发生在工作日地铁车厢内上下班或上下学的乘客之间，如偷手机、扒窃等财产犯罪，或拥挤车厢内的冲突（争夺位置或性骚扰）等暴力犯罪。

地铁站的犯罪机会取决于站点的环境属性、社区环境及其区位。这些研究结果为环境犯罪理论提供了支持：环境特征（从站台及车站的照明和闭路电视等微观环境到社区与城市环境等宏观环境）及犯罪行为之间是存在联系的，即乘客在乘坐地铁时暴露的环境及其特征与犯罪行为有关 [7, 9, 17, 27]。从 2 个案例研究可知，尽管地铁系统的环境特征有所差异，地铁载客量都会影响站点的犯罪机会。因此，在提出任何预防犯罪干预措施之前，我们必须非常详细地记录犯罪案件的时间和地点（例如高峰和非高峰时段、不同车站、站点不同的位置、车厢）[1]。

未来研究应重视信息通信技术的使用以提高机动性和安全性。移动传感器及相关技术的使用带来了一些新的研究问题，如特定个体的移动数据可能有助于了解地铁站点环境与安全感之间的关系。通过移动传感器收集的数据有助于研究特定时间特定地点时乘客安全感低下的问题。

5 结论

研究在控制不同的案例数据和研究方法前提下，对比瑞典斯德哥尔摩和巴西圣保罗地铁系统犯罪案件在时间和空间上的分布情况，其中最重要的结论是地铁系统的安全不仅取决于地铁站的自身条件，也受站点在城市中的区位影响。这意味着每个利益相关方都有责任确保乘客的安全得到法律的保障。他们必须保护乘客在整个乘车过程中的安全。这便需要通过各方合作来确保车厢内、车站内、以及乘客往返于交通节点的环境安全。然而，在车站层面仍有很多事情可以做，为此需要非常详细地记录犯罪案件的时间和地点，并考虑站点客流量的差异。这意味着我们需要对高犯罪率的特定地铁站及时间采取特别措施，尤其是高峰期，2 个案例均表明市中心地铁站在拥挤时更易发生犯罪。结果还表明，需改善环境的监视作用（如消除黑暗的角落等），尤其是在商业区、中心及外围站点。且无论采取何种预防犯罪措施都必须考虑到每种犯罪类型的时间和空间分布状态。

除了处理地铁系统安全问题的管理者之间的合作带来的挑战之外，还需要对用户需求的关注，尤其是那些由性别、年龄及残疾引起的特别需求。研究交通环境中的受害度和安全感应不仅考虑乘客的年龄或性别，更应考虑某些特殊群体的内在特征。作为一名贫穷的残疾人会使其“不利条件相互加成”从而影响其成为受害者的可能性和（或）他（她）体验世界的方式。仅以性别为例，流动性和安全性在个体性别上是有差异的 [28]，然而公共交通系统仍采用性别中性政策。

地铁犯罪的预防必须考虑到具体的国家和城市问题。例如，圣保罗地铁系统无法满足客流承载量的需求，公共汽车、货车、通勤列车和地铁都无法满足乘客的机动性。圣保罗地铁站的安全状况和拥挤程度反映了更为根本的问题，即保障每个人乘坐公共交通的权利。这不仅仅与巴西或南美的背景相关，更是关乎全世界数百万乘客的现实问题。由于大多

数的交通环境数据来自于北美和西欧的研究，因此迫切需要对那些城市不断扩张的国家的安全状况也进行评估，尤其是非洲和亚洲的国家。未来研究应揭示安全交通系统的具体挑战并反映乘客的安全需求。

文章以斯堪的纳维亚地区及南美地区为背景，对相关地区既往地铁安全研究的缺失进行补充。本研究通过强调瑞典和巴西地铁系统的共同点，为交通安全研究做出一定贡献，但各地区安全环境措施的制定应当参照当地特定安全条件的研究结果。尽管存在一定的局限性，但笔者考虑到地铁站的环境属性，社区环境及其在城市中的位置，向更好地了解地铁系统安全状况又迈进了一步。

（编辑 / 王晨宇 王一兰）

注释：

①图 1-1 由斯德哥尔摩地铁运营商提供（2016 年）；图 1-2 由圣保罗地铁运营商提供（2016 年）；图 2 来源于 2006 年 3 月—2009 年 2 月斯德哥尔摩公共交通数据库和 2013—2015 年圣保罗地铁运营商数据库。

② 表 1 数据来源于引文 [28]；表 2 数据来源于引文 [2]、[5]。

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Mobility is a basic requirement for efficient and sustainable modern cities. Public transportation is key for achieving economic prosperity and sustainable mobility in cities, despite current challenges such as safety concerns caused by crime and terrorist threats in these environments. Having detailed knowledge about the nature of the safety conditions is essential for an informed debate on urban sustainability in public transportation, in particular, in metro systems. A very limited number of studies have focused on the relationship between metro station design and rates of crime and disorder. Focusing on crime in metro stations provides us with snapshots of a city's risk over time and space using aggregated data by station[1]. The environmental design of a metro station and its auxiliary sections, such as entrances and exits, influences surveillance and may affect opportunities for crime. This means that what happens at the stations depends not only on their physical environments, but also on the human activities that take place at these transportation nodes when individuals are on the move.

In this article, we discuss lessons learned from assessing crime and public disorder in two major metro systems: Stockholm (Sweden) and São Paulo (Brazil). We compare temporal and spatial patterns of crime in these metro systems in two national contexts. We also attempt to compare findings from these two case studies to reason about the influence of the environment on crime and public disorder, drawing from a conceptual theoretical framework suggested by Ceccato[2]. This is important since one way to prevent crime in metro environments is by making it difficult to happen. In order to do that, a key element in this approach is identifying the underlying drivers of a particular type of offence in time, and in each particular environment. Situational crime prevention focuses on creating strategies to reduce crime opportunities. These strategies focus on changing the environment and how it is managed, thus closing off opportunities for crime[3].

This article summarises and builds on the work done by Ceccato and colleagues in Sweden, Brazil and elsewhere in international research[2, 4-7]. The structure

of the article is as follows. We start by discussing the theoretical principles of the analytical model, and then we frame the two case studies followed by a description of the methodology and results obtained. The article ends by highlighting commonalities and differences, in terms of crime levels and patterns and how they relate to these two major transit environments.

1 Theoretical background

1.1 Temporal patterns of crime

Crime opportunities are neither uniformly nor randomly distributed in space and time[8], but they do follow rhythmic patterns of human activities. Temporal variations of crime are related to people's routine activity. Underground stations concentrate people on a daily basis. Routine activity theory[9] suggests that an individual's activities and daily habits are rhythmic and consist of patterns that are constantly repeated. Most crimes depend on the interrelation of space and time – that is, on spatial-temporal variations in offenders' motivation, and on the presence of suitable targets and responsible guardians. Since metro stations are places where people converge at particular times, they act as crime generators[10], at least during particular time windows[1]. Routine activity theory suggests that the more outdoor activities in which individuals participate, the more criminal opportunities. Thus, areas that act as crime attractors, such as some transportation nodes, provide opportunities for criminal acts regardless of day of the week or month of the year. Monthly and seasonal variations in crime in transport nodes have long been documented in the international literature but patterns depend on the type of crime[11].

1.2 Spatial patterns of crime in metro stations

Crime (and public disorder) at a metro station is determined by its physical and social environmental attributes; the characteristics of the immediate environment and neighbourhood as well as the relative position of both the station and neighbourhood in the city. This conceptual model relies on principles of environmental criminology, situational crime prevention and Crime Prevention through Environmental Design (CPTED) [2].

1.2.1 The physical and social characteristics of metro stations

A station's vulnerability to crime depends on its physical environment and the type of social interactions that take place at this particular setting. The physical environment refers to the hardware of the station; it is composed of everything that is present and 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.

Metro stations have entrance/exit areas (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 of their layout, metro stations are often composed of five settings: platform, transition, lobby, entrance/exit, and finally the immediate surroundings. The platforms are where trains arrive, and where passengers embark, disembark, or wait. The transition area commonly includes stairs and elevators from the platform up to the lobby, where control gates and 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 directly from the street or via doorways, stairs, elevators, or tunnels. The immediate surroundings are what individuals see within a few meters' distance from the entrances/exits. Piza and Kennedy describe how both easy entrance and exit from stations, as well as passengers' lack of familiarity with metro stations, lead to increased opportunity for offenders to commit crimes[12]. Research has long shown that those physical characteristics of stations (and bus stops), such as lighting, design, location and security hardware, reduce crime opportunities [6-7, 13-16]

1.2.2 The metro station and neighborhood context

Safety conditions at a metro 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; 2) the demographic and socio-economic 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[17] in Chicago, and later coined as the main reference to social disorganization theory. Social disorganization theory links many forms of crime with weak informal social control, often present in high-crime areas, regardless of their location in a city. Thus, in general, economically deprived areas with low social control run higher risk of crime, as do metro stations located in those areas[2], but there are exceptions. LaVigne[14] showed that Washington's subway crime rates by station do not correlate with crime rates for the census tracts where Metro stations are located.

1.2.3 The station in the city context

A metro station is often planned to move as many 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. Environmental criminology has shown how city centers are more criminogenic than other parts of the city[7, 18-21]. 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 metro 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, which are bound to create more crime opportunities.

2 The case studies

2.1 The two metro systems

2.1.1 Stockholm metro system

Stockholm is well supplied by its one hundred stations, connected to buses and commuter trains. 47 are underground (most central) and 53 above ground. There are three lines: Red, Green and Blue (Fig. 1-1). In this study, we will report on crime and public disorder events in the whole Stockholm metro system, but because of data limitation the modelling section will use 82 per cent of the stations, those located in Stockholm municipality. Stockholm is part of an archipelago, and therefore water occupies a large part of the urban landscape as the city is spread over a set of islands on the southeast coast of Sweden. The islands are well connected by roads and an efficient public transportation system, comprising of buses, the metro system, rail systems and commuter trains. Stockholm is also peculiar because it is a Scandinavian city; the short days of its cold, dark winter limit life outdoors, but long daylight hours allow for days full of activity in the spring and summer. Stockholm is the capital and most populous city of Sweden, and the most populous city of Scandinavia, with 910,000 inhabitants in 2016.

2.1.2 São Paulo metro system

The study area is composed of 62 stations in the São Paulo metro (Metrô de São Paulo), excluding some expansion (65 stations total), which is the main rapid transit system in the city of São Paulo, the largest in Brazil and the second largest system in South America (Fig. 1-2). The system was founded in 1968 with one line, and today has five lines (74 km, Fig. 1-2) carrying 4,600,000 passengers per day on 154 trains operating from Sunday to Saturday, from 4：40 AM to midnight (1：00 AM on Saturdays). The Metro runs within São Paulo municipality — a municipality with 12 million inhabitants. The city is also served by a set of companies providing commuting train service. São Paulo's size is unique even within Latin America. It is Brazil's largest municipality and constitutes South America's largest metropolitan area. The metropolis is a global city and the most populous city in Brazil, the Western Hemisphere and the Southern Hemisphere.

2.2 Data and methods

In Stockholm, crime and public disorder data were gathered from Stockholm Public Transport (2006—2009) in combination with Police recorded statistics (we will not discuss police data in this study). Instead of using crude data of crime events by stations, rates per 1000 passengers were calculated based on the passenger flow at each station. Data from the fieldwork inspection (checklists) were inputted in spreadsheets and then imported to GIS, together with data on land use, crime, and demographic and socio-economic data of the population. Stations and crimes were mapped as point data, whereas the Stockholm demographics and socio-economic data were linked to small unit statistics. 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 location of automated teller machines (ATMs), schools, police offices and state-operated alcohol retail outlets in Stockholm. The study is based on comprehensive fieldwork combined with Geographical Information Systems techniques and modelling[2].

In São Paulo, this study makes use of data from Delpom (Delegacia de Polícia Metropolitano) and Polícia Civil reports by passengers (2010—2015) obtained from São Metro company (aggregated by type and station and by time (2013—2015)) as well as from an SMS-service (2014—2015), which allows for the reporting of crime and other incidents that happen during metro trips and/or on metro premises. Crime incidents include property and violent crimes, such thefts, muggings and any sort of violence, including sexual violence and sexual harassment. In order to standardise the levels of incidents, the number of passengers was also obtained from Metro, which are estimates of the number of passengers in a working day by station during peak and off-peak hours, as well as the total number of personnel (security and overall) by station. The methodology combines Geographical Information System (GIS) and crime records with data collected using Google street view and other secondary data into a set of regression models[5].

3 Results

3.1 The nature of crime and public disorder

Different recording practices significantly affect levels of crime and events of public disorder in metro systems, which makes any comparison of crime figures between systems a difficult task. The exact numbers of criminal incidents also vary by data source. In Stockholm, for instance, property crimes are more often recorded in official police statistics than the Stockholm Public Transport Company. Below we discuss some of the major trends from the datasets provided by both Public Transport Companies but strictly speaking, comparisons should be made with caution, both because of the different recording practices and because the datasets are not from the same time.

Overall, most events that take place at the metro stations are events that affect the perceived safety but may not be crimes. Common recorded offences are threats and physical assault among passengers and against personnel, more commonly in the Stockholm metro system than in São Paulo's, where property crimes compose the largest share of records. Property crimes can generally be divided into two types: those against persons and of objects. The latter includes thefts in wagons and stations (mobile phones are more common in São Paulo than in Stockholm, for instance), shoplifting in shops and food stores, and the theft of bicycles and cars, which are common around metro stations, in parking lots, or on streets.

In São Paulo's metro system, 62 per cent of reported incidents are property crimes such as

thefts and robberies. Fights and other types of violence compose nearly a fifth of the records. Cases of sexual assault and sexual harassment are often under recorded[5]. It is important to note that there are other events that are not counted in this dataset (some of them are gathered elsewhere, e.g. via SMS-service), such as cases of physical damage against property, begging, and other types of public disorder. The incidents that are recorded are an integral part of the records in the Stockholm metro system, and constitute the large majority of recorded incidents (around 80 per cent). There, 20 per cent of reported incidents to the transportation company are considered crimes. The majority of these crimes are fights (about 40 per cent), vandalism, and threats, followed by other types of violence. Most reports of violence are against personnel, guards, drivers, or passengers. Police robbery data also show a large portion reported at stations, although the majority of all records at stations are related to places like shops and supermarkets. Public disorder events, which constitute the large majority of the incidents, include unlawful activities or acts of anti-social behaviour, such as public urination, drug use, loitering, public drunkenness, and unjustified use of emergency brakes, fire extinguishers, or fire hoses in wagons/stations[2].

3.2 Temporal patterns of crime and disorder

Knowing when crime happens in transit environments is fundamental for tailoring effective crime prevention interventions. Violence and theft happen during rush hours in both metro systems, but these offences show different hourly patterns. In São Paulo, these offences reflect the crowdedness of the system in the morning and evening (around 8 ∶ 00 and 9 ∶ 00 and 18 ∶ 00—19 ∶ 00), while in Stockholm, the peaks vary by offence type: thefts take place between 14 ∶ 00 and 19 ∶ 00 and violence encounters occur after midnight (Fig. 2).

In Stockholm, significantly more incidents are recorded during weekends and holidays than weekdays, perhaps because people often engage in 'unstructured activities' during weekends and holidays, which tend to be more criminogenic (e.g., going to parties, drinking) than those perform during 'normal' weekdays, which often involve more 'structured activities'[13]. In the São Paulo metro, the amount of recorded crime events varies by type of crime, but overall follows a stricter pattern of daily weekdays' routine activities, such as going to school/work, and then back home again. For example, for sexual harassment and/or sexual violence, most incidents are recorded from Monday to Friday (20 per cent on Mondays and Tuesdays and only 6 per cent on Saturdays) when people are going to or returning from work. The most significant peak happens during rush hour in the morning, between 8 ∶ 00 and 9 ∶ 00, and in the late afternoon between 18 ∶ 00 and 19 ∶ 00[5], when most trains and lines are overcrowded.

Data from a longer time period would be needed to test seasonal variations in the São Paulo metro, but despite this, results show that there are slight increases in the number of cases in June and July, which are the winter season in Brazil. In the Stockholm metro system, violent crimes are seasonal (e.g., robbery, fights, threats), concentrated in the Swedish hot months of the year (Tab. 1[22]). Important to remember that our case studies are embedded in two different geographical contexts. The Stockholm metro system is located in Stockholm, Sweden, a Scandinavian country with long dark winters, while the São Paulo metro system is in Brazil, a tropical country with average annual temperatures above 21 degrees Celsius. These seasonal differences are bound to define particular patterns of routine activity that, in their turn, impact crime levels in these transit environments.

Tab. 1 Violent crimes by season, Stockholm, 2006—2008.

	Crime levels Mean	F-test	Scheffe
Winter (1)	48.19	2,901*	1.3/3.1
Spring (2)	51.90		
Summer (3)	53.54		
Autumn (4)	51.98		

* Significant at 90% level.

3.3 Spatial patterns of crime and disorder

In both metro systems, results show that the central stations might concentrate the highest number of incidents, but they do not keep their top position if crime and events of public disorder are standardized by daily passenger flow. Instead of using crude data of incidents by stations, rates per 1,000 passengers are calculated for all types of crime for both Stockholm and São Paulo, revealing a more interesting spatial pattern. As a result, the so-called "end-stations" show higher rates of events (crime and public disorder) than stations located in the inner-city areas (exceptions are the stations: Medborgarplasten and Skanstull, for thefts). More interestingly, stations such as Hjulsta, Farsta Strand, Hässelby, Vällingby and Hagsätra (all peripheral stations) show high rates regardless of crime type, which is a relevant piece of information for safety interventions. In São Paulo, the pattern is similar but the centrality remains for all types of crimes. High rates of reporting are more often found at stations located within a 3 km radius from the city centre following a distance decay distribution from Sé station, in the inner city area (examples are stations Paraíso and Liberdade). Regional transportation hubs tend to also show high rates of recorded crime after standardising by daily passenger flow (e.g. stations Brás, Palmeiras-Barra Funda, Tatuapé).

Some stations are crime-specialized. For instance, in Stockholm, stations such as Rinkeby more often have problems with violence, while Västertorp station more often has high theft rates, and Norsborg, has dominantly many records of vandalism. Some of these stations belong to areas

with higher than average general crime rates, and they often belong to areas of mixed land use, near commercial areas, and/or are end-stations, where people meet. In São Paulo, this crime specialization is not as clear as in the metro system but for sexual harassment, for instance, sexual violence is concentrated at the busiest central stations and at stations that also attract all sorts of violence and events of public disorder[5]. Variations of crime events per lines are also found in both metro systems[5, 23].

3.4 Explaining levels of crime and disorder at metro stations

Using the conceptual model discussed in section 2, crime and public disorder at stations in these two metro systems were modelled as a function of the physical and social environmental attributes at the station (more in detail in Stockholm than in São Paulo because of the data limitations), the characteristics of the immediate environment and neighbourhood, and finally, the relative position of both the station and neighbourhood in the city. Below we discuss the main commonalities of the two case studies' findings. Before drawing any conclusion, please keep in mind that the modelling strategies are slightly different because of the differences in data availability for Stockholm and São Paulo metro systems.

In both metro systems, results show that opportunities for crime are dependent on stations' environmental attributes, the type of neighbourhood in which they are located, and city context — but the effect of these dimensions is dependent on the metro system itself, types of offences and time of the day. Table 2 summarises some general characteristics that alone, or combined with other factors, affect criminogenic conditions of these transit nodes. Whether the stations were central or not is one of the most important factors affecting the levels of crime in both metro systems; inner city areas tend to attract more crime. However, end-stations can be highly criminogenic as the Stockholm case shows. Another commonality is the influence of land use around the stations, in particular the presence of risky facilities (e.g. restaurants) or a lack of facilities that discourage crime and public disorder (police stations). Note that information on the internal design of São Paulo's metro stations was limited, which directly affects the modelling. Yet, we found that some features were recurrent in both case studies, such as the presence of dark corners, which directly affect the visibility and surveillance. Below we discussed in more detail the specifics of each case study.

In Stockholm, for instance, for rates of total crime and disorder, variables that indicate presence of guardianship and illumination explain 30 percent of the variation in crime rates; it goes up to 52 per cent when other variables that indicate formal social control (number of police stations within 100 meters), distance to city centre and city context are added to the model. For violence, the goodness of fit of the model nearly doubles when variables depicting the surroundings of the stations were added to the model (e.g. open entrances, distance to city centre, population density). These variables were also important to explain the variation of property crimes, such as thefts and robberies[1, 13].

In São Paulo, for total crime rates, factors reflecting internal features of the stations and their location explain around 30 per cent of the variation of total crime in the São Paulo metro. For thefts and robberies, the conditions found at stations located in inner city areas are better predictors of property crimes than for violence. High rates of recorded violence tend to be more common at stations that have relatively large numbers of CCTVs and metro personnel, a presence of physical and social disturbance, and a presence of dark corners. Similarly, high rates of violence are observed in stations outside of inner city areas, most often those that are part of regional centres, close to shopping malls. These stations are well connected to the urban fabric, accessible but relatively small, and surrounded by more affluent neighbourhoods, and so might be closer to bicycle storage facilities or restaurants[5].

4 Lessons learned from Stockholm's and São Paulo's metro systems

Metro stations are criminogenic places, but certain stations are more often targeted by acts of crime and disorder than others and this vulnerability may change over time. Most crime in metro stations shows variations over time; they tend to occur more often during certain periods of the day, week or year. These temporal variations are often related in the literature to changes in people's routine activities throughout the day, the week and year[24-25]. Calling for another interpretation of this temporal variation, Harries et al.[26] 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, where there is a possibility of externalizing stress. These findings mirror the literature that suggests that conflicts often reach a peak when people meet each other in their free time. However, some of these encounters happen during normal weekdays, as passengers are in the metro, inside of wagons, going to, or home from work or school. These encounters may lead to property crimes such

Tab. 2 Characteristics of the stations, neighbourhood surroundings and city context

Stockholm metro	São Paulo metro
Objects hindering visibility/surveillance	Presence of dark corners
Corners, hiding places	Numbers of CCTVs, larger stations
Number of platforms, larger stations	Visible physical and social deterioration
Few people around stations	Peripheral/central stations
Peripheral/central stations	Proximity to bicycle storage
Fewer police stations	Commercial, restaurants
Residential mobility	Surrounded by affluent neighbourhoods

as theft of mobile phones and pickpocketing, or to violence, such as conflicts inside wagons when crowded (fights for a place or sexual violence).

Opportunities for crime at the stations are dependent on the stations' environmental attributes, neighbourhood context as well as the station's location in the city. These findings provide support for environmental crime theories that claim a link between environmental features and crime at several geographical levels, from the micro-environment of the platform and stations (e.g. illumination, CCTVs) to neighbourhood and city contexts — namely environments that passengers are exposed to as they travel to/from these stations[7, 9, 17, 27]. From both Stockholm and Sao Paulo case studies, we see that regardless differences in the environmental context of these systems, the flow of passengers regulates the amount of crime opportunities. It is therefore essential, before any intervention is suggested, that we map out where crime and disorder incidents occur in time and space, in very detailed level (e.g., peak and off peak hours, by stations, by sections of the stations, inside wagons). Example of how this is done see[1].

Future research should investigate the use of ICT - Information and Communication Technology to enhance mobility and safety. The use of mobile sensors and similar technologies opens up a number of new research questions. For instance, individuals' detailed movement data could help in understanding the link between station surroundings and fear of crime. Of particular importance is the need to investigate why people are afraid at particular times and at particular stations; here, data collection via mobile sensors could be of assistance.

5 Conclusions

In this study, we set out to compare the criminogenic conditions of two metro systems over time and space keeping in mind differences in data availability and methodology from these case studies: Stockholm, Sweden and São Paulo, Brazil. The most important message from these studies is that safety conditions in metro systems depend not only on the local conditions of the stations, but also the surroundings in which these stations are located. This means that each stakeholder has the responsibility to make sure passengers are safe within jurisprudence. They must also aim to safeguard passengers' safety by adopting a door-to-door perspective, in other words, having a 'whole journey approach'. This demands cooperation from those responsible for ensuring safety in the wagons, on station premises, and in the surrounding environments where people walk to and from transport nodes. Yet, there are things that can be done at the station level. In order to do that, we need to map out where crime and disorder incidents occur in time and space, in very detailed level, taking differences in flow of passengers into account. This means that we need to target particular stations and at certain 'time windows' when most crime happens. In rush hours in particular, crowded conditions at core stations facilitate crime in both metro systems, as it was illustrated in Stockholm and in São Paulo. Findings also indicate the need for improvements in surveillance (e.g. eliminating dark corners), especially in areas with commercial land use, in central and peripheral stations. Regardless the type of interventions, actions must consider the temporal and spatial dynamics of each crime type.

On top of challenges with cooperation between actors that deal with safety in metro systems, there is also a lack of focus on users' needs, particular those determined by gender, age and disability. Victimisation and perceived safety in transit environments should not only consider users' age or gender but reflect the intersection of a set of individuals' characteristics. Being a disabled and poor individual creates 'synergic layers of disadvantage' that affect one's likelihood to be a victim of crime and/or the way he or she experiences the world. Just taking gender as an example, we know that both mobility and safety are gendered[28], yet public transportation systems adopt gender-neutral policies.

Crime prevention programs in metro systems must account for city and country specific problems. In the case of São Paulo, for example, the metro system runs over-capacity; buses and vans, together with commuting trains and the metro system, do not provide sufficient mobility services for passengers. Safety conditions and crowded stations in the São Paulo metro reflect a more fundamental problem, namely, the need to ensure individuals' rights to public transportation. This evidence is not only relevant for the Brazilian or South American contexts, but it reveals the reality of millions of passengers around the world. Since most of the current evidence in transit environments comes from studies in North America and Western Europe, there is an urgent need to assess safety conditions in countries with growing cities, not least in Africa and Asia – these future studies should potentially reveal the specific safety challenges of these transit systems and/or their passengers' safety needs.

This article brings together evidence from Scandinavian and South American contexts, which has so far been lacking in the international literature. Although this study contributes to the literature on transit safety by highlighting commonalities between the metro systems, any safety intervention elsewhere should be informed by evidence from specific local safety conditions of each particular transit system. Despite its limitations, this article is a step forward towards a better understanding of safety conditions in metro systems when taking into account the stations' environmental attributes, neighbourhood context as well as their location in the city.

Notes:

① Fig. 1-1 provided by Stockholm Metro, 2016; Fig. 1-1 provided by Sao Paulo Metro, 2016; Fig.2 was adapted from Stockholm Public Transport Database, March 2006 to February 2009 and São Paulo metro company database, 2013—2015.

② Tab. 1 was adapted from references[28]; Tab. 2 was adapted from references[2], [5].

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