RISK FACTORS INFLUENCING BICYCLE THEFT IN MILAN (ITALY): A SPATIAL ANALYSIS

G. SALVANELLI, C. PORTER & I. MARINO

ABSTRACT

1. BACKGROUND

The positive effects of cycling to personal health and the environment are well known. As a logical consequence, researchers in the areas of transportation and health have extensively studied the risks that cyclists face, such as injury, exposure to carbon monoxide and cardiac disease. However, urban authorities grapple with a less explored risk related to cycling, namely theft. A case in point is Milan where bicycle theft continues to rise, even while the overall offending rate is declining (FIAB, 2019). The accelerating risk could be linked to the bicycle's high utility for door-to-door transportation and the relative ease of liquidating it, whole or as parts (Mburu & Helbich, 2016). Studies show that bicycle owners are three times more likely to lose possession through theft than are owners of automobiles and motorcycles (Mburu & Helbich, 2016; Zhang, Messner & Liu, 2007). In this respect, it is not surprising that repetitive victimization greatly undermines policies to promote cycling because a large proportion of victims neither replace their stolen bicycles nor resume cycling (Koetse & Rietveld, 2009).

2. PURPOSE

This research firstly explores Milan as a case study to address place-specific risk factors for bike-theft at the micro-level while controlling for daily variation. The presence of certain public places (universities, train-stations, police-stations, bars/restaurants, pharmacies, retail' centers, abandoned building, sport' centers, swimming pools, schools,

hotels, libraries and congress' centers) was evaluated against locations of bicycle theft between 2011 and 2019 and risk effects were estimated.

3. METHOD

This research used the *Risk Terrain Modelling (RTM)* methodology to bring multiple sources of data together into QGIS (e.g. geographical, urban and environmental information) and connect them to environments bike-thieves live. It offered insights about places and events in order to add context to 'big data' and make predictions on future crimes (Caplan & Kennedy, 2010);

In terms of data collection, geographical data was collected via the Milano Geoportale website with its geo-data packs including all the shapefiles for the local authority district of Milan (i.e. city boundary, roads, important buildings, police stations, train stations). Then, crime data was retrieved from the RUBBICI database as an online Bikes' registry platform collecting thousands of bicycle thefts' reports in Milan (Rubbici, 2020). In this respect, it led to a final dataset of 2227 crimes (some of them were however crossed out because of their spurious nature).

4. RESULTS

Results showed various levels of risk for bike theft stemming from different land-use facilities depending on the actual 'time' of the day.

- **From 8:00 to 12:59**. The presence of facilities such as subway stations (RRV, Relative Risk Value[1] = 5.877), pharmacies (RRV = 4,664), universities (RRV =

[1] **Relative Risk Value – RRV** = The relative risk value shows the weighted values of the selected risk factors. In other words, it shows how much a risk factor correlates with crime occurrence. The higher is the RRVA the stronger is the impact of a factor on determining crime occurrence. All of the risk factors were operationalized based on both density and proximity function of half-block (50 mt). Using the "best model" for creating high-risk areas, the RTM created a composite risk terrain map.

3,529), Train Stations (RRV = 2,206), libraries (RRV = 2,115) and congress centers (RRV = 2,051) increased bicycle theft in 43 micro-places distributed across NIL(s)[2] Duomo, Brera and Buenos Aires (figure 1, and table 1);

- **From 13:00 to 18:59**. Subway stations (RRV = 5,354), libraries (RRV = 3,468), pharmacies (RRV = 3,284), universities (RRV = 3,140) increased bicycle theft in 31 micro-places distributed across NIL(s) Duomo, Brera, Centrale and Buenos Aires (figure 2, and table 2);
- **From 19:00 to 23:59**. Pharmacies (RRV = 6,137), subway stations (RRV = 5,622), libraries (RRV = 2,571) and public parks (RRV = 1,907) increased bicycle theft in 54 micro-places distributed across NIL(s) Duomo, Centrale, Vigentina, Magenta San Vittore and Guastalla (figure 3, and table 3);
- **From 00:00 to 07:59**. Subway stations (RRV = 9,437), pharmacies (RRV = 4,764) and libraries (1,633) increased bicycle theft in 69 micro-places distributed across NIL(s) Duomo, Centrale, Vigentina, Magenta - San Vittore, Guastalla, Pagano, TIcinese, Garibaldi – Repubblica, Isola and Loreto (figure 4, and table 4).

5. DISCUSSION

This study has investigated the risk that emanates from urban land-use features to provide grounds for security-directed intervention on bicycle theft. Risk analysis was performed over road network instead of the conventional census areas, a choice consistent with the knowledge that most cycle thefts are on-street incidents (Zhang et al, 2007; Mercat & Heran, 2003). Three observations contribute new evidence to the existing criminological literature.

[2] NIL = "Nucleo d'identità locale", it refers to each Milan's neighborhoods.

Firstly, studies have traditionally relied on census-based socioeconomic indicators to quantify crime risk in given areas (Jean, 2008; Kautt & Ronceck, 2007). The findings here, however, show that public amenities are far more profound determinants of risk. After adjusting for the effects of daily variation and examining all the variables comparatively, more than half of the selected amenities had high risk and predictive estimates. In this respect, the negative influence generated at this distance contradicts the literature that has always applied Collective Efficacy Theory to classify affluent areas as being safe (see e.g. Curman et al, 2005; Sampson et al, 1997). The difference in observations here possibly owes to the presence of (a) high priced bicycles and (b) numerous commercial/leisure premises in such areas which attract criminals, as consistent with Rational Choice Theory (Cohen & Felson, 1979).

Secondly, in line with Mburu & Helbich (2016), it was revealed no influence of police stations on bicycle theft at any distance. This finding contradicted one of our hypothesis, given that police stations have been linked with crime reduction in the past (Braga et al, 2015). It might be argued that a number of crime-specific factors could be overriding this safety effect, such as the lack of direct offender-victim contact and the delay in discovering bicycles as missing (Mburu & Helbich, 2016).

Thirdly, the results of this study also supported the theoretical knowledge that risk stems from certain elements of the physical environment (Brantigham & Brantigham, 1993; Cohen & Felson, 1979). For example, subway stations and universities influenced risk at all distances (from 50mt to 300mt), in line with the literature linking these types of amenities with increased crime levels (Groff & Lockwood, 2014). Surprisingly, pharmacies appeared to be a relevant risk's influencer at all distances too, despite there is no previous evidence that links them with increased crime levels. It might be argued that, because more than 86% of Milan's pharmacies are located in the proximity of road junctions, many bicycles transit through them and that provide, on a hand, many crime

opportunities to bike thieves and, on the other hand, various escape routes the latter can take. However, in regard to this, further comparative research is needed.

6. CONCLUSION

This paper has examined the influence of different urban facilities on place-specific risk of bicycle theft. It constitutes one of the very few incidence-based bicycle theft risk analysis, which also concurrently assesses amenity-related influences while adjusting for daily offending variation. In tandem with the differences in offending behaviors and opportunities that set bicycle theft apart from other crimes, the unique outcomes that were observed in this study contribute significant evidence to the literature on victimization. The findings also highlight the important contribution of urban facilities to crime statistics. When controlling for daily variation, effects of urban land use are important predictors of the risk of bicycle theft. Specifically, since the findings indicate that not all facilities pose the same level of risk, risk-estimation models should depict the cumulative weighted influence of nearby facilities. The results could also be used to support the promotion of attributes that are associated with a low risk of bicycle theft.

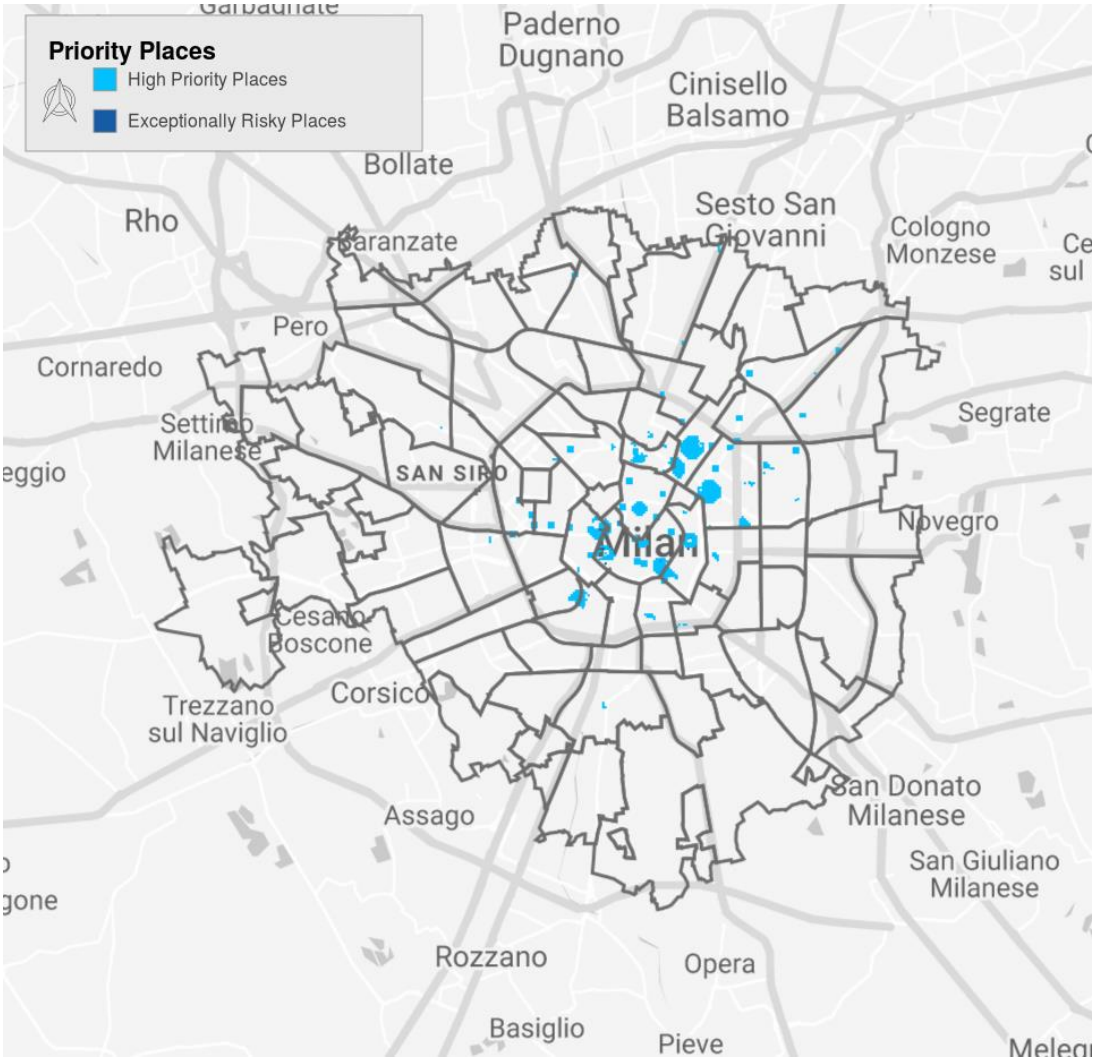

Figure 1. Exceptionally risky areas for bike theft between 8:00 – 12:59

Risk Factor	**Operationalization**	**Spatial Influence**	**RRV**
Subway Stations	Density	100	5.877
Pharmacies	Proximity	300	4.664
Universities	Density	200	3.529
Train Stations	Density	300	2.206
Libraries	Proximity	300	2.115
Congress Centres	Proximity	300	2.051
Schools	Density	300	1.479

Table 1. Relative Risk Values (RRVs)[3] for bike theft between 8:00 – 12:59

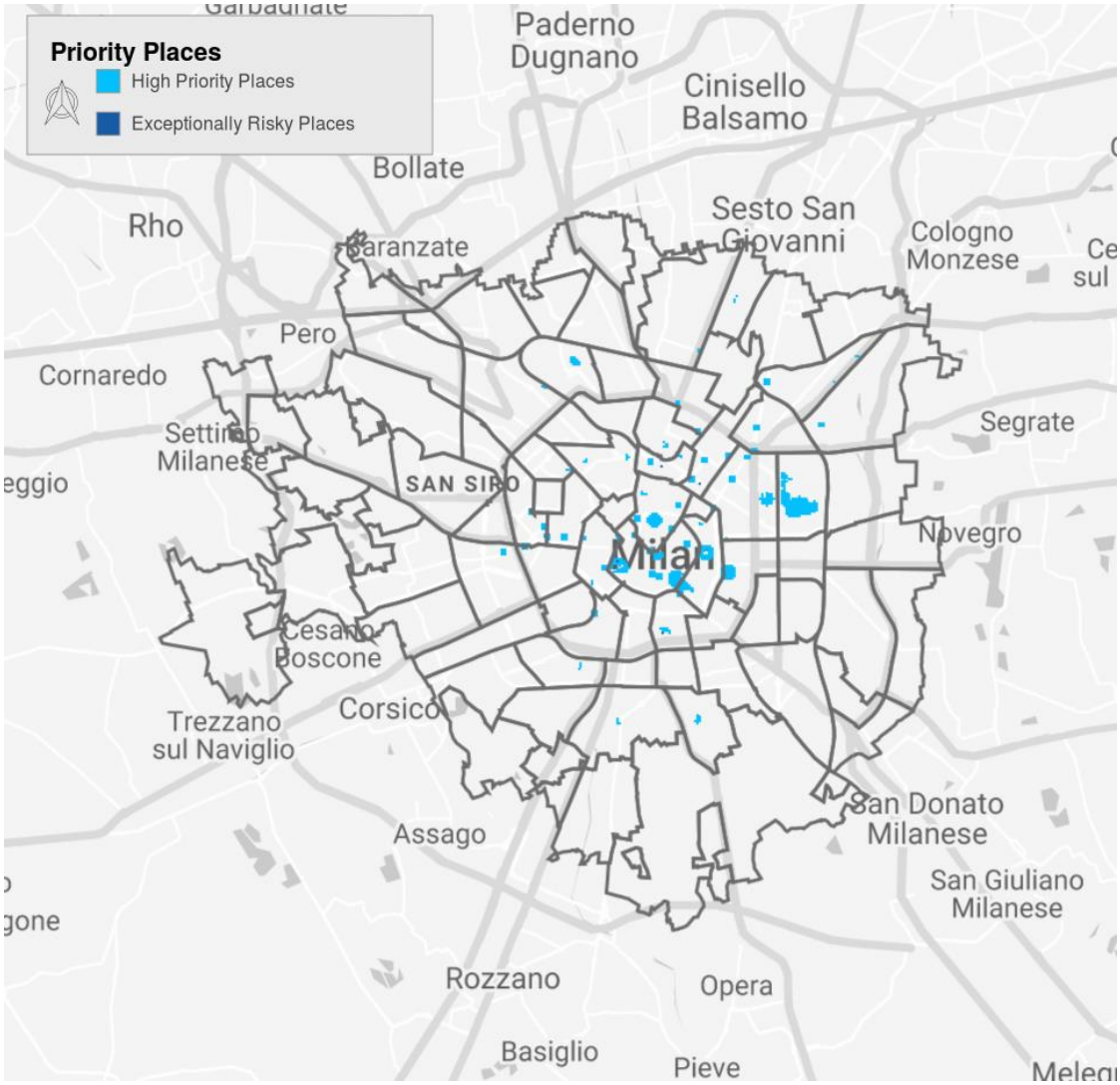

Figure 2. Exceptionally risky areas for bike theft between 13:00 – 18:59

Risk Factor	Operationalization	Spatial Influence	RRV
Subway Stations	Density	100	5.354
Libraries	Proximity	300	3.468
Pharmacies	Proximity	300	3.284
Universities	Density	200	3.140
Congress Centers	Proximity	300	1.779

[3] Places affected by a risk factor with a RRV of 6 are twice as risky compared to places affected by risk factor with a RRV of 3.

Sport Centres	Proximity	300	1.729

Table 2. Relative Risk Values (RRVs) for bike theft between 13:00 – 18:59

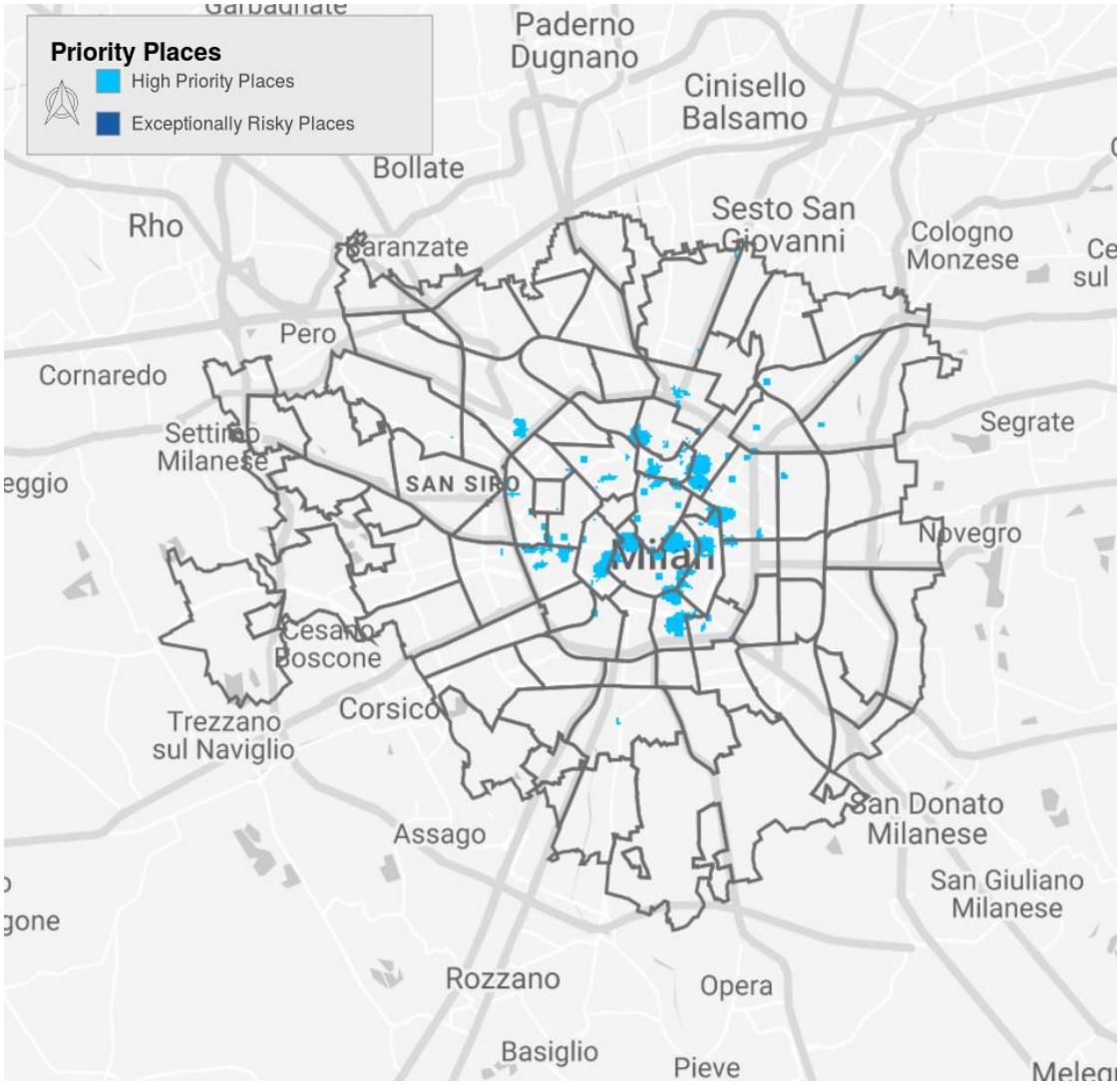

Figure 3. Exceptionally risky areas for bike theft between 19:00 – 23:59

Risk Factor	**Operationalization**	**Spatial Influence**	**RRV**
Pharmacies	Proximity	300	6.137
Subway Stations	Density	100	5.622
Libraries	Proximity	300	2.571
Public Parks	Density	300	1.907
Congress Centres	Proximity	300	1.839

Table 3. Relative Risk Values (RRVs) for bike theft between 19:00 – 23:59

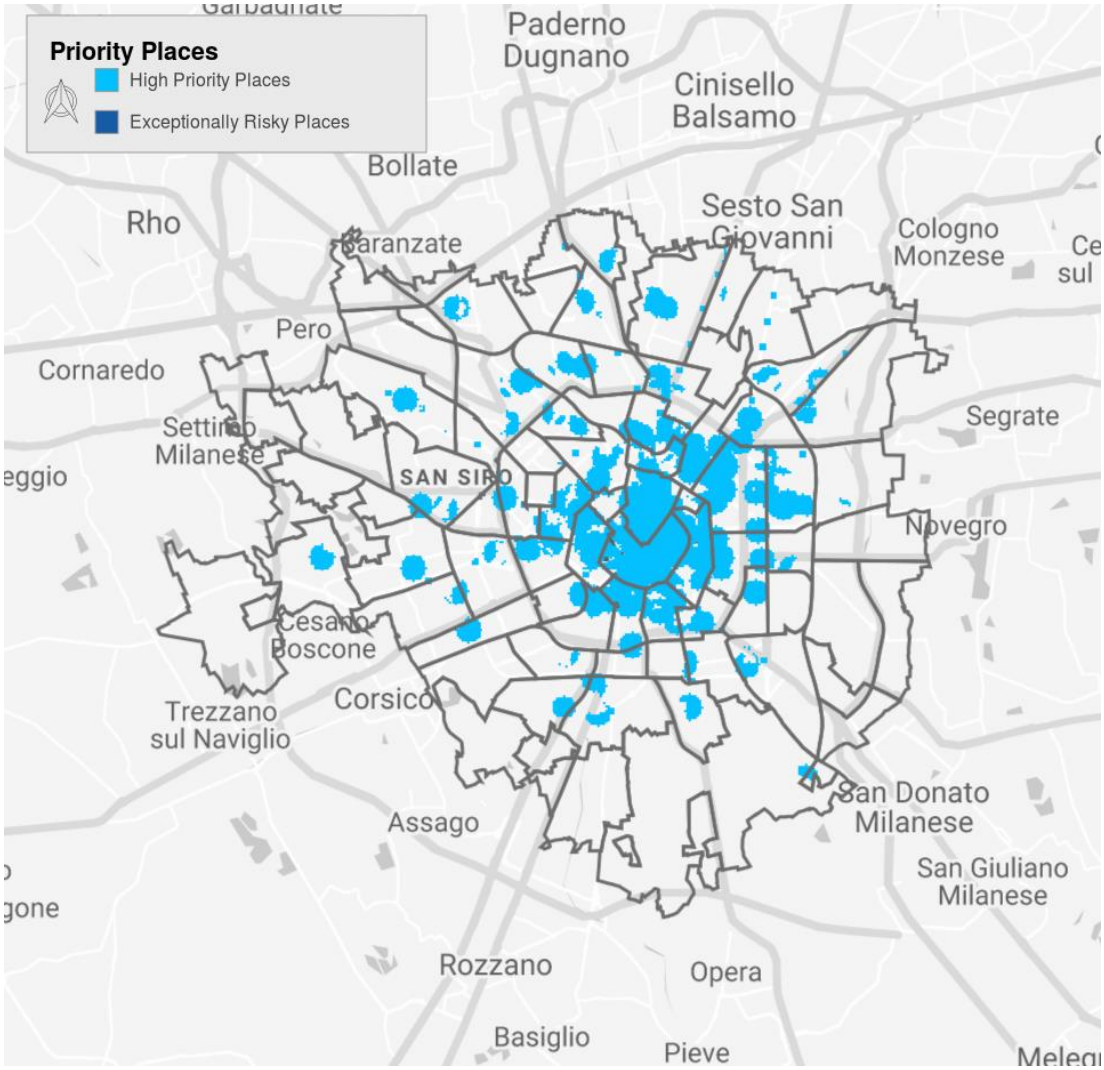

Figure 4. Exceptionally risky areas for bike theft between 00:00 – 07:59

Risk Factor	Operationalization	Spatial Influence	RRV
Subway Stations	Proximity	300	9.437
Pharmacies	Density	100	4.764
Libraries	Proximity	300	1.633

Table 4. Relative Risk Values (RRVs) for bike theft between 00:00 – 07:59

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Contact email: giacomo.salvanelli@misapinstitute.com (G. Salvanelli)