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ESTIMATION OF THE RISK OF SNATCHING IN A SUBURB:
Case study of Soka, Saitama prefecture, Japan

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Abstract

In this paper, the estimation model for the risk of street crime using Space Syntax is created and shown. Crime in Japan was increasing with a peak of 2002, and crime prevention became regarded as important in the field of urban and architectural planning and design. In the scientific field, the feature of space where street crime happen easily or space where the density of street crime is high have been clarified with accumulation of previous research. For example, the regression model using them as an explained variable has been estimated. In analysis of the city level, population, land use, etc. were used as explanatory variables and in the street level, the distance to urban facilities, the spatial characterization of the street, etc. were used as explanatory variables However, there is little research on the feature of the space where the probability of encountering criminal damage is high. Then, the purpose of this research is to build the estimation model about the damage risk using base data of urban space, road data, or Space Syntax, and the factor which contributes to a damage risk is clarified. Moreover, the space where a crime happens easily was compared with the space which encounters criminal damage easily and the common feature and difference of space composition were clarified.

Field-survey was done at suburban residential area in Soka city, Saitama prefecture, Japan. Firstly, passing and stopping quantity of pedestrians, cars, and etc. on streets within about 1 km from railway station were measured by the counting survey by walking through some routes. Three rules were set up in this investigation. (1) Two investigators walk along the route predetermined to the opposite directions every other hour. (2) Investigators walk at a fixed speed. (3) Investigators count the number of the person, the bike or the car which passed or stayed for every segment. This work was repeated 16 times each by all the 6 routes. The sum total data for 16 hours was used for analysis. The criminal damage risk was computed from criminal data and the observed amount of passings. Multiple linear regression analyses which made computed damage risk (or street crime density per unit meter) explained variable and made some indices from Space Syntax and spatial character the explanatory variables were performed, and the factors which contributes to a damage risk and street crime generating density and the difference was clarified.

Keywords: *Crime prevention, Risk, Crime Density, Suburb, Eyes on the street*

Theme: *Urban Space and Social, Economic and Cultural Phenomena*

1. Introduction

1.1 Background

In Japan, crime prevention is regarded as an important social issue. Therefore, urban planning should address crime prevention and target common crimes of opportunity such as snatches, sneak thievery, and vehicle theft. These crimes account for approximately 76.5 percent of recognized criminal offenses (The National Police Agency 2011). It is considered that “Crime Prevention through Environmental Design” (CPTED) effectively prevents crimes of opportunity. In addition, many studies utilize CPTED when studying urban planning from a crime-prevention perspective.

This type of research has rapidly developed during the past twenty years. Previous studies have focused on a variety of crimes such as burglaries (Hino & Kojima 2007，Matsukawa & Takaie 2009), suspicious persons targeting children (Ago & Matsunaga 2010), and vehicle crimes (Takizawa & Kawaguch 2006). These studies, examined snatches on the basis of information obtained from “criminal occurrence maps,” which local governments and police agencies share with the public. Kohsaka (2005) clarified the relationships between criminal occurrence points and the distance from transport hubs or main streets. Ishikawa (2009) analyzed the relationships between criminal occurrence points and the spatial characteristics of streets. The results indicated that the factors influencing snatches were sight distance, street width, and the number of escape routes. Kinashi (2010) revealed that other factors influencing snatches were household density, population density, and the presence of financial institutions, transport hubs, police stations, and open space.

Outside Japan, space syntax is used to clarify the relationship between criminal occurrence and street structure in cities (Hillier & Sahbaz 2005，Hillier & Sahbaz 2008，Nubani & Wineman 2005). In Japan, only Nagaie’s research (2008) indicated a correlation between integration value and criminal occurrence points.

1.2 Purpose

To avoid the risk of crime, we should comprehend not only environmental factors but also the characteristics of locations that have a high “risk of crime victims.” We defined risk of crime victims as the risk of crime damage suffered per person. A higher risk of crime victims implies that there are fewer potential victims as compared to the number of crimes. Previous studies have clarified environmental factors of many crimes, but the characteristics of locations that have a high risk of crime victims have not been investigated. Therefore, in this study, we created an “estimation model for the risk of crime damage.” We clarified the environmental factors of locations at which many potential victims experience greater risk of crime damage.

1.3 Target crime

To analyze the characteristics of such locations, we required information on potential victims and crimes in the target area. Information on potential victims was obtained using a field survey and data related to criminal occurrence points were obtained from the annually published safety–security maps in Soka, Saitama Prefecture, from 2007 onward. We used this data, spanning from 2007 to 2011. After considering this data, this study focused on snatches in Soka as the target crime.

2. Research method

2.1 Study area in Soka

We analyzed data on crimes occurring within a 1 km radius of Soka Station. Figure 1 depicts the locations at which snatches occurred within the study area.

Soka, a commuter town with a large housing district, lies in southeast Saitama Prefecture, and its southern section is contiguous with Adachi-ku, Tokyo. Soka Station is an entrance to Soka, and its eastern entrance is a shopping district containing many shops integrated into the station building. Therefore, the scale of the shopping and entertainment district is small. In 2011, 79300 passengers commuted through Soka Station each day. Many snatches occurred in the study area and the occurrence density differed between the entertainment district near the station and the housing district further away from it.

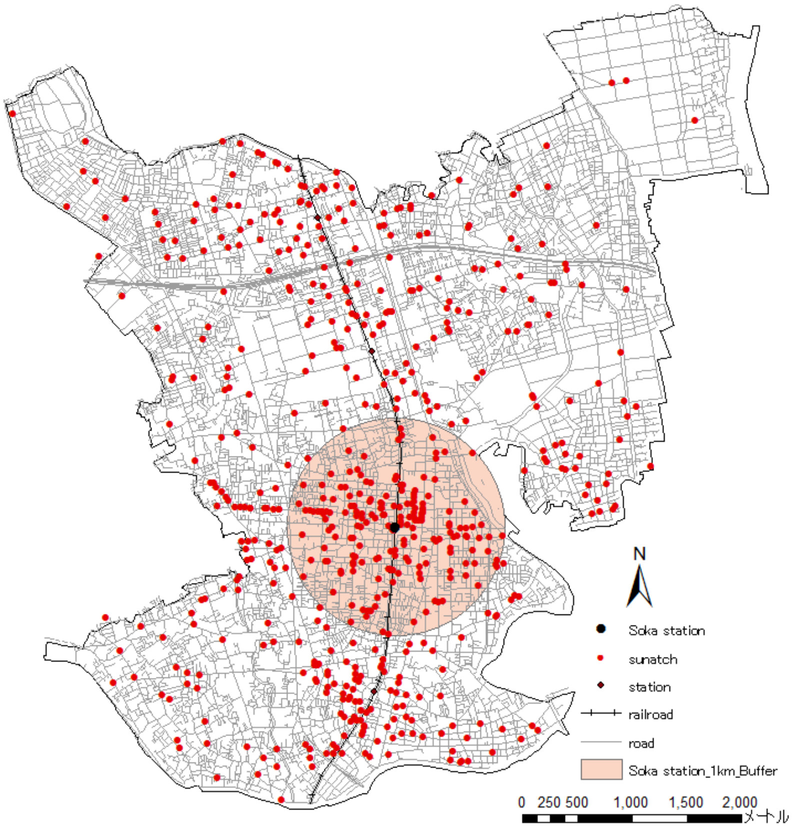

Figure1 Locations at which snatches occurred in Soka

2.2 Defined risk of snatching damage and survey links

In this study, we defined "low risk" and "high risk" as follows: If snatches occurred on the link where the number of potential victims on each link is bigger than the mean number of potential victims on every link, the link is low risk. If snatches occurred on the link where the number of potential victims on each the link is smaller than the mean number of potential victims on every link, the link is high risk. We regarded links with in a 100 m radius sight distance from the snatching points as occurrence links. Figure 2 indicates the survey and occurrence links.

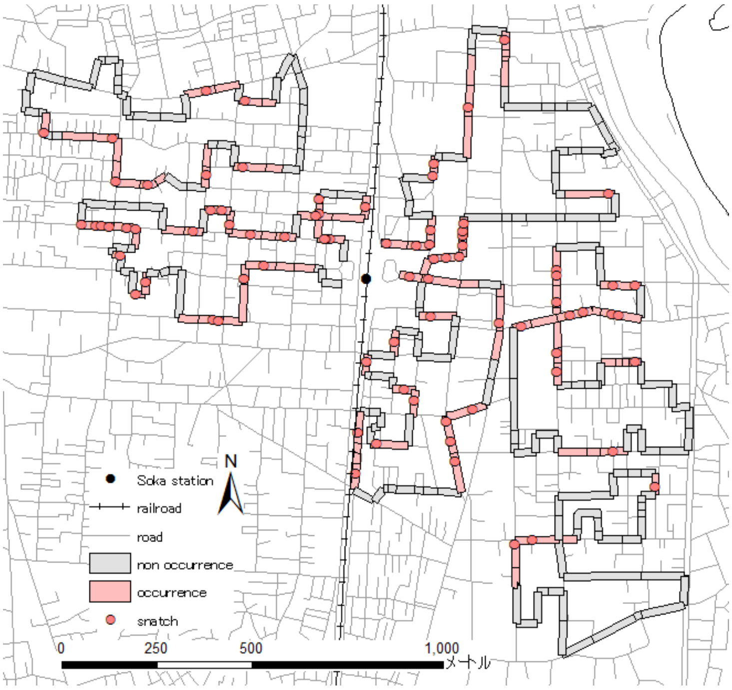

Figure2 Survey links

2.3 Determining the number of potential victims

To calculate the risk of snatching, we needed to confirm the number of potential victims on the links. Therefore, we surveyed traffic volume using investigators present in the area. We referred to the research method advocated by Building Research Institute (2009). Accordingly, 24 investigators conducted the survey from 11 a.m. to 8 p.m. in November. An over view of the survey and its procedure are as follows:

(1) Survey streets

We created six routes within a 1 km radius of Soka Station, as illustrated in Figure 2. It took approximately 45 minutes for the investigators to complete the route. Different routes passed through different areas, for example, the shopping and entertainment district near the station, the housing districts further away from the station, and along the elementary schools and parks.

(2) Survey procedures

1) On each route, from 11 a.m. to 8 p.m. daily, two investigators traveled back and forth at a consistent speed, once an hour, eight times per day.

2) The investigators counted the number of pedestrians (high school students or older and high school students or younger), bicycle riders, drivers, and the person who is in the streetside (high school students or older and high school students or younger) passing through each link.

3) Finally, we totaled the number of pedestrians (high school students or older), bicycle riders, and the person who is in the streetside (high school students or older). We regarded the sum as the number of potential victims of snatching. The safety–security maps of Soka revealed only the locations and not the times at which snatches occurred. Therefore, we used data collected everyday from 11 a.m. to 8 p.m. (16 hours). Figure 3 shows the high- risk and low- risk links for snatching.

Figure3 High- risk and low- risk links

3. Derivation of the estimation model for snatch risk

This section reports the binomial logistic regression. We considered high and low risk of snatching as calculated in the previous section, as response variables. Further, we regarded street connections and local environmental factors as predictor variables, assuming that they affect snatch risk.

First, we explain the hypothesis linking predictor variables with snatch risk.

3.1 Variables associated with local environmental factors

・Street width: Narrow streets enable criminals to easily approach potential victims, and wide streets enable criminals to easily escape.
・Number of buildings: In locations with many buildings, several people may notice criminals' movements.
・Non-residence ratio: Persons other than inhabitants can observe criminals' movements in locations with a high non-residence ratio.
・Distance from main street: Criminals' escape is easier if they are near main streets.
・Distance from financial institution: There are many potential victims near financial institutions; therefore, many snatches occur in these locations.
・Distance from Soka Station: There are many potential victims near the station; therefore, many snatches occur in this location.
・Step depth from Soka Station (angular): Many criminals prefer locations with easy access to transport hubs.

3.2 Variables explaining street connections

We assumed that street connections would contribute to snatching occurrences because most snatches occurred on streets. Therefore, in this study, we focused on space syntax and adopted segment analysis (angular) to analyze each link. Table 1 explains the correlation between segment analysis (angular) and snatch risk, and we adopted Radius = 6. Figure 4~8 are an analysis result of the segment analysis (angular; Radius = 6).

Table1 Relationship between segment analysis (angular) and snatch risk

	Correlation ratio	P value
Integration R1	0.1834	0.0458
Integration R2	0.2599	0.0043
Integration R3	0.3041	0.0008
Integration R4	0.3216	0.0004
Integration R5	0.3346	0.0002
Integration R6	**0.3423**	**0.0001**
Integration R7	0.3430	0.0001
Integration R8	0.3396	0.0002

	Correlation ratio	P value
Choice R1	0.1052	0.2548
Choice R2	0.1290	0.1620
Choice R3	0.1326	0.1507
Choice R4	0.1265	0.1704
Choice R5	0.1190	0.1975
Choice R6	**0.2214**	**0.0155**
Choice R7	0.2137	0.0196
Choice R8	0.2083	0.0230

	Correlation ratio	P value
Node Count R1	0.1248	0.1763
Node Count R2	0.2565	0.0049
Node Count R3	0.3073	0.0007
Node Count R4	0.3258	0.0003
Node Count R5	0.3407	0.0001
Node Count R6	**0.3507**	**0.0001**
Node Count R7	0.3528	0.0001
Node Count R8	0.3508	0.0001

	Correlation ratio	P value
Total Depth R1	0.0439	0.6356
Total Depth R2	0.2521	0.0057
Total Depth R3	0.3106	0.0006
Total Depth R4	0.3301	0.0002
Total Depth R5	0.3466	0.0001
Total Depth R6	**0.3544**	**0.0001**
Total Depth R7	0.2482	0.0065
Total Depth R8	0.2858	0.0016

	Correlation ratio	P value
Mean Depth R1	0.3683	0.0000
Mean Depth R2	0.2412	0.0082
Mean Depth R3	0.1717	0.0620
Mean Depth R4	0.2594	0.0044
Mean Depth R5	0.3068	0.0007
Mean Depth R6	**0.3296**	**0.0003**
Mean Depth R7	0.3341	0.0002
Mean Depth R8	0.3406	0.0002

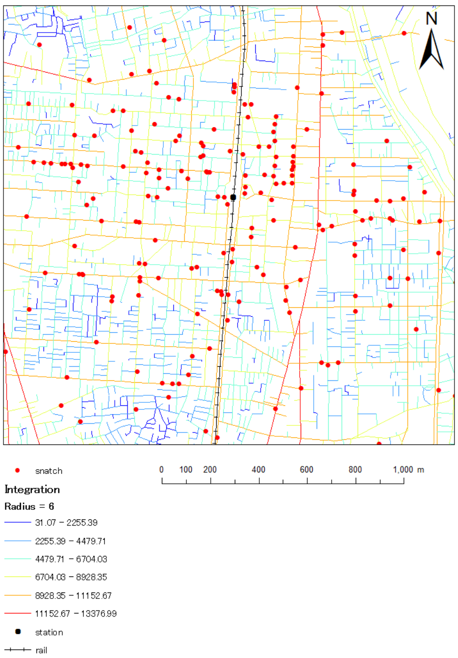

Figure 4 Integration

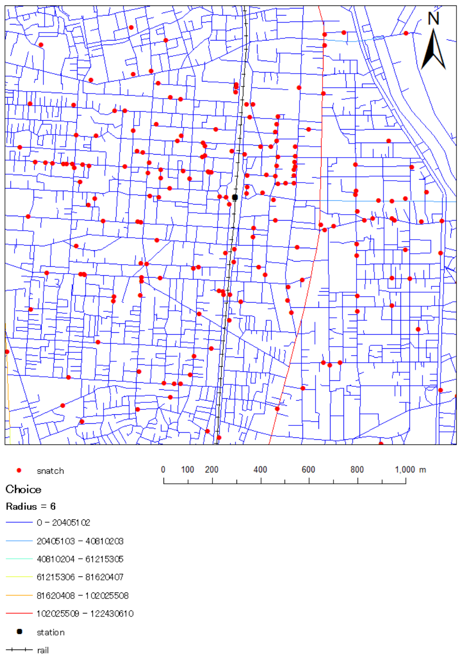

Figure 5 Choice

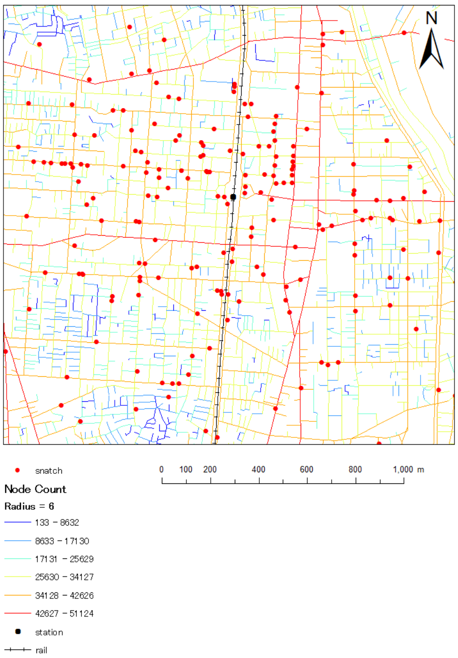

Figure 6 Node Count

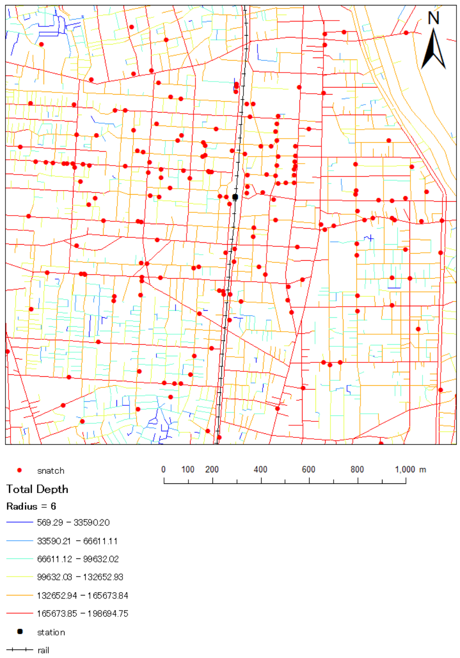

Figure 7 Total Depth

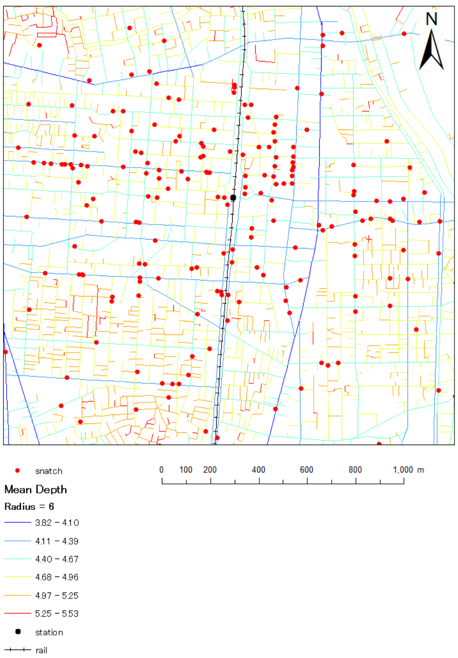

Figure 8 Mean Depth

The hypotheses related to the relationships between variables and snatch risk are as follows:

・Integration: Many criminals prefer streets near the city center because this facilitates easy escape to another street.
・Choice: A frequently used path has many potential victims.
・Node Count: Many criminals snatch on streets from where they can escape to many

segments within the R6 range.
・Total Depth: On the links that have high local complexity, it is difficult to escape.
・Mean Depth: On the links that have higher mean depth, it is difficult to escape.

3.3 Construction of the evaluation model

Due to multicollinearity among explanatory variables, we excluded Integration(VIF=323.06), Node Count(VFI=1108.96), and Mean Depth(VFI=10.04) while constructing the model. The explanatory variables used the step wise method (step-up procedure based on the Wald test). The significance of each variable was assessed using the Wald test. Using the odds ratio, we evaluated the strength of each variable's influence on the risk of being a crime victim. The contributing rate of the model used the Nagelkerke R2. The goodness of fit of model was assessed using the Hosmer – Lemeshow test.

3.4 Results of logistic regression analysis

Table 2 depicts the model of risk of being a crime victim. Because the contributing and prediction rates were approximately 60 and 80 percent, respectively, the model has a high degree of precision. About an odds ratio, a width of street (= 0.774) and the number of buildings (= 0.735) can read first that they are less than 1.0. We assumed that the risk of being a crime victim rises on wide streets, which enable easy escape. However, the result revealed the reverse to be true. This is likely due to sidewalks often being established on wide streets. The result suggesting that areas with a high number of buildings are low risk supports the hypothesis. Since not only the person on a street but the person in a building may see, it is thought that it is not desirable as a crime place for a criminal plan person.

Although "the distance from Soka Station" and "coefficient of Total Depth" show the positive value, since the odds ratio shows about 1.0, they can say both variables that they do not affect a risk. Although it is in the tendency for snatching to occur frequently, in "a place near from a station", and "monotonous space", in a damage risk, the result that they do not influence can be said to be new discovery. On the other hand, from the result obtained by this model, it was not able to clarify about the factor which raises a damage risk. It will be necessary to find the factor which contributes to the place where a damage risk is high from now on.

Table2-1. Results of logistic regression analysis

variable	coefficient	Significance probability	Odds ratio	Contributing rate	Significance probability
Width of street	-.256	.001	.774	.591	.470
Distance to station	.007	.000	1.007		
Number of buildings	-.307	.002	.735		
Total Depth (Radius 6)	.000	.026	1.000		
Constant term	6.368	.006	582.813		

Table2-2 A hitting ratio of logistic regression analysis

	low	high	%
low	37	12	75.5
high	12	58	82.9
%			79.8

4. Summary

New knowledge on the risks for potential snatching victims was clarified by investigating foot traffic around Soka Station and analyzing the factors that influence the risk of becoming a snatching victim.

Specifically, when the number of buildings and width of street increase, risks for potential snatching victims decrease. On the other hand, we were not able to clarify the factor to increase a risks but it was clarified that the distance from the station and Total Depth did not change risks.

This knowledge is important for future urban planning and crime prevention. Furthermore, the knowledge acquired from this study can facilitate better crime prevention among residents. Finally, the acquisition of additional traffic data would enable a more precise risk calculation.

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