Use of Correspondence Analysis to Analyze Feelings of Insecurity Among the Elderly Concerning Snatch Occurrences on Roads

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Abstract
By using a correspondence analysis the authors related the characteristics of the roads in a target area with the feelings of the elderly concerning snatch occurrences on these roads. The target area was divided into 10 groups, by using the k-means clustering method. The results can be summarized as follows: (1) Group 2 presents the highest rate of snatch occurrence (45.2%) and a feeling of security, implying that individuals feel an unreasonable sense of security on unsafe roads. The roads in this group have the largest percentage of shops (45.6%), longest roads, largest sidewalks, and the lowest ratio of length of open spaces/parking lots to the road length. (2) Groups 4 and 5 present low rates of snatch occurrence (12.5%, 8.3%), implying that individuals harbor an unreasonable sense of insecurity concerning safe roads. The roads in these groups have the largest percentage of houses (65.5%, 62.5%), shorter roads (34.9 m, 49.9 m) than the average, not many sidewalks, and the highest ratio of length of open spaces/parking lots to the road length. Based on these results, the authors clarified the characteristics of the roads in a target area, clustered based on the reasons why people feel secure/insecure about snatch occurrences on roads.

Keywords: snatch; feeling of insecurity toward snatch; walking environment; elderly people; correspondence analysis

1. Introduction
Prevention of both crime and the fear of crime are important factors in improving the quality of life. Many studies have adopted crime prevention through environmental design (CPTED) (Wallis et al., 1980) theory. The CPTED model identifies four elements for potential modification: natural surveillance, access control, territoriality, and activity support. However, even though these elements can be reinforced, the feeling of insecurity might not be eliminated. There is a gap between objective risk and perceived risk. An individual might feel secure in an unsafe place or insecure in a safe place. This implies that, at times, the human sensor might not work properly, which might, in turn, lead to mental fatigue.

The routine activity theory (RAT) (Felson et al., 1995) is one of the main theories in environmental criminology. RAT states that when a crime occurs, the following three events simultaneously occur in the same space:
1. A suitable target is available;
2. A suitable guardian to prevent the crime from happening is lacking; and
3. A likely and motivated offender is present.

The feeling of insecurity might also emerge when a guardian is present and an offender is not. Particularly with elderly people, the fear of crime might also lead to the restriction of outdoor activities — including walking and cycling — increased car use, and staying at home. Those who fear crime might, therefore, be less physically active and, as a result, decrease the quality of their lives even in safe places. Safety and security are essential for successful, sustainable communities. Not only are such places well designed, but they are also places where freedom from crime and fear of crime improves the quality of life.

This study aims to assess the correlations between the occurrence of snatch and the reasons for the increase in elderly people's feelings of insecurity toward snatch thieves, in walking environments using data collected through geographic information systems (GIS), which describe the characteristics of the roads such as the length; depth; area; and number of sidewalks, parking lots, and open spaces.

2. Literature Review
Several studies in the past have focused on the fear of crime and crime itself. Kinashi et al. (2008) found that the accessibility to railway stations and national roads tends to increase crime, and the occurrence of crime
is influenced by population density and household density; self-anticrime activities are more effective if the target area is sub-divided into small zones. Nagaie et al. (2008) analyzed the relationship between the fear of crime and space syntax. Their study presents the possibility of identifying territoriality by using axial maps and isovist maps and how the fear of crime is related to the values of high integration and isovist areas. Nakamura et al. (2006) analyzed the relationship between crime occurrence and six types of spatial factors by using a factor analysis. The close-control type is related to the occurrence of crime. Arima et al. (2008) clarified the characteristics of the place of crime and fear of crime in a city center using the methods of crime mapping and spatial analysis, and they found that the fear of crime was caused by darkness, road visibility, blind alleys, maintenance, pedestrian traffic, views of residences, and imagination. Conklin, J.E. (1975) contends that street crime would decline if interpersonal relations were closer, if interactions among the residents of a community were more frequent, and if the social bond was closer. Lagrange et al. (1989) conducted research by utilizing specific indicators for the fear of crime and demonstrated that older persons are not highly fearful. As indicated herein, older adults are probably less fearful of most types of crime than younger adults are. Stafford et al. (2007) have reported that the fear of crime is associated with poorer mental health, reduced physical functioning on objective and subjective indicators, and a lower quality of life. Hino et al. (2005) reported that the adopt-a-park-program contributes to a sense of security in parks, since surveillance and territoriality enhance security and that it correlates with litter in parks, which leads to vandalism and undesirable acts. Himura et al. (2003) have reported two types of crime — those that cause physical damage and those that cause material losses — and divided them into three types of area according to the occurrence of the crime and feelings of insecurity. Amemiya et al. (2009) have reported that the degree of fear of crime, number of areas where residents fear crime, and concentration of places that are feared did not vary among districts.

Unlike these studies, this paper focuses on the relationship between crime occurrence and the reasons behind the feelings of security/insecurity toward snatching, by using a correspondence analysis and data collected through GIS.

3. Data Collection and Description
3.1 Data collection
In this study, the authors used three types of data: Snatch occurrences, feelings of security/insecurity toward snatch, and data obtained through GIS.

3.1.1 Snatch occurrence data
This data was obtained from the police department. It consists of 112 snatch cases that occurred between January 2003 and October 2008. These cases are grouped according to the place of occurrence, that is, those occurring on the same road, and where the total number of observations is 100.

3.1.2 Feelings of fear of crime/safety concerning snatch
This data was collected from 121 senior citizens, older than 60, who were interviewed from January 15 through 19, 2009. The interviewees reside in an area that is 7 km from the center of the prefecture in Japan and is characterized by 988 roads; more than 26% of the residents were older than 65 and aging. This area was deliberately selected to achieve a better understanding about the feelings of insecurity or security among elderly people in an area with roads portraying the characteristics of the ones in this study; for instance, roads that have a record of high snatch occurrence and those that coexist after a land readjustment project and non-land readjustment project.

3.1.3 Field survey and data acquisition using GIS
By using GIS, data on the characteristics of the road space; road length/width; sidewalk length, width or area; and open space/parking lot length, width, and area facing the road was gathered. These data were confirmed by conducting a field survey investigating the several uses of buildings.
belonged to the age range of 70–74, followed by 75–79.

3.2.2 Period of residence and feelings of security/insecurity concerning snatch

Those who had been living in the area for 41–60 years harbored the highest feelings of insecurity, which was 50.8%. From among those who had resided for less than 20 years, 44.4% harbored feelings of insecurity. The trend revealed by these data is that the fear of crime increases together with the period of residence, with the exception of those who had been living in the area for more than 61 years (Table 2.).

3.2.3 Resident apprehension/feelings concerning roads

Residents were questioned regarding 12 situations where they might feel secure (Table 4.) and 16 where they might feel insecure (Table 5.), when walking through an area comprising 495 roads, out of a total of 9883. From among the 988 roads, the authors collected more than 10 responses for 83 of them (Table 3.).

3.2.4 Reasons for secure feelings concerning snatch

From among the 1766 responses, brightness was considered the primary reason for feeling a sense of security concerning snatching (in 358 cases), followed by well-separated sidewalks and driveways (in 323 cases), and high traffic roads (in 320 cases) (Table 4.).

3.2.5 Reasons for insecure feelings concerning snatch

Of the 749 responses, darkness was considered the primary reason for feeling unsafe about snatching (in 163 cases), followed by people standing idly on the roadside (in 106 cases) and low traffic roads (in 105 cases) (Table 5.).

3.2.6 Secure/insecure feelings concerning road distribution

Figs.2. to 4. show the location of the roads on which the respondents felt more secure/insecure with regard to snatch. The green roads on the maps represent the "reasons for feeling secure" and the red ones the "reasons for feeling insecure." As for the data from the previous figures, Fig.2. indicates the brightness/darkness on roads, Fig.3., the roads with high traffic and low traffic density, and Fig.4., the well-separated sidewalks and their condition.
3.2.7 Relationship between reasons for secure/insecure feelings and the occurrence of snatch

Table 6. shows the relationship between road safety and security concerns regarding snatch, regardless of the reasons. From a total of 1378 respondents, 526 felt secure on a safe road, 334 felt secure on an unsafe road, 116 felt insecure on an unsafe road, and 402 felt insecure on a safe road. These responses reveal that there is an incorrect functioning of the human sensor toward secure/insecure feelings. Individuals feel secure in unsafe places (defined as "unreasonably secure" in this paper), which might, in turn, lead to mental distress.

4. Correspondence Analysis

A correspondence analysis is a descriptive/exploratory technique designed to analyze simple two-way and multi-way tables containing some measure of correspondence between the rows and columns. The results provide information, which is similar to those produced by factor analysis techniques, and explore the structure of categorical variables included in the table. The most common table in this type of analysis is the two-way frequency cross-tabulation table, as shown in Fig.5., where the background table shows that there is one answer and 83 roads per person interviewed, which is a total of 121 testees and 10043 rows. The front table shows that there are 28 reasons for harboring feelings of insecurity/security toward snatch for each road (83 roads), and a total of 2324 rows. In this paper, the authors use a table that presents the roads (83) and reasons for secure feelings (12 reasons) and insecure feelings (16 reasons) toward snatch. This paper uses the following settings (Table 7.).

Table 6. Reasons for Secure/Insecure Feelings and the Occurrence of Snatch

| Safe – security | Unsafe – security | Unsafe – insecurity | Safe – insecurity | Total (%) |
|----------------|-----------------|--------------------|-----------------|-----------|
| 326(38.2)      | 334(24.2)       | 116(8.4)           | 402(29.2)       | 1378 (100) |

(Unit: Responses)

dangerous situations, or insecure in safe places (defined as "unreasonably insecure" in this paper), which might, in turn, lead to mental distress.

Fig.2. Brightness/Darkness on Roads

Fig.3. High Traffic and Low Traffic Roads

Fig.4. Well-separated Sidewalks and their Condition

Fig.5. Cross-tabulation Table

Table 7. Correspondence Analysis Settings

| Road No. | Reasons for secure feelings (28) | Reasons for insecure feelings (28) |
|----------|----------------------------------|-----------------------------------|
| 1        | Radius of curvature              | People on the roadside             |
|          | Irregular occurrence of pedestrian |                                    |
| 2        | 285                          | Windows and balconies of buildings face the street |
|          | Windows and balconies of buildings do not face the street |                                    |
| 3        | 0                               | People on the roadside             |
| 4        | 0                               | People on the roadside             |
| 5        | 0                               | People on the roadside             |
| 6        | 0                               | People on the roadside             |
| 7        | 0                               | People on the roadside             |
| 8        | 0                               | People on the roadside             |
| 9        | 0                               | People on the roadside             |
| 10       | 0                               | People on the roadside             |
| 11       | 0                               | People on the roadside             |
| 12       | 0                               | People on the roadside             |
| 13       | 0                               | People on the roadside             |
| 14       | 0                               | People on the roadside             |
| 15       | 0                               | People on the roadside             |
| 16       | 0                               | People on the roadside             |
| 17       | 0                               | People on the roadside             |
| 18       | 0                               | People on the roadside             |
| 19       | 0                               | People on the roadside             |
| 20       | 0                               | People on the roadside             |
| 21       | 0                               | People on the roadside             |
| 22       | 0                               | People on the roadside             |
| 23       | 0                               | People on the roadside             |
| 24       | 0                               | People on the roadside             |
| 25       | 0                               | People on the roadside             |
| 26       | 0                               | People on the roadside             |
| 27       | 0                               | People on the roadside             |
| 28       | 0                               | People on the roadside             |

* Reasons for insecure/secure feelings toward snatch (see table 4, 5)
** 1: response 6: non-response
*** Unit: Person
5. Results

A correspondence map displays two dimensions that emerge from the principal component analysis of point distances. The points are displayed in relation to these dimensions. The results of the correspondence analysis gained the coordinates (Fig.6.), which were then used in a k-means clustering method, and 10 groups were classified, as seen in Table 8.

5.1 Occurrence of snatch and the reasons for feelings of insecurity/security

Snatch occurrences actually occurred in only 9.9% (100) of all the roads analyzed in this area (988). The rate of snatch occurrences on the 83 roads from which more than 10 responses were collected was 26.5% (22 cases). Interesting results emerge from Groups 2, 4, and 5. In Group 2, the snatch occurrence was 45.2% (14 cases), but the respondents stated the highest number of reasons (3S: clear view of approaching people; 6S: high traffic roads; 7S: use of buildings – ground floors used as convenience stores and factories; 8S: no open spaces, such as parking lots or parks; 9S: well-separated sidewalks and driveways; and 11S: people walk on a separate portion of the road with no obstructions) for feeling secure on these roads.

![Fig.6. Row and Column Points, Symmetric Normalization](image)

![Fig.7. Distribution of Roads for which More than Ten Responses were Collected](image)

| Dimensions | Measure | Standardize | Normalization |
|------------|---------|-------------|---------------|
| CHISQ      | RCMEAN  | SYMMETRICAL |               |

Table 7. Correspondence Analysis Settings
groups 4 and 5, the snatch occurrence is 12.5% (one case) and 8.3% (one case), respectively. However, the respondents stated five reasons for feeling insecure. Group 4 highlighted 3F: irregular occurrence of passersby, 5F: bad visibility, and 9F: conditions of the sidewalk, while Group 5 highlighted 6F: low traffic roads and 14F: know where the incident occurred (memory) on these roads (Table 8.). In groups 1, 3, and 8, the reasons for feeling insecure/secure coexist. Group 6 has only one road but three reasons for feeling insecure (use of buildings — ground floors used as convenience stores and factories, signs for security advisories, and buildings with windows and balconies that do not face the street) on unsafe roads. Group 9 has only two roads but the respondents feel secure (no people on the roadside) on safe roads.

| Group | Road No. | Reason for feeling insecure/secure ID* | S/Roads* (%)* |
|-------|----------|--------------------------------------|---------------|
| 1     | 359, 363, 397, 435, 436, 461, 538, 539, 542, 578, 598, 600, 780, 1305 | 1S, 4F, 5S, 11F, 13F, 15F | 3/14(21.4) |
| 2     | 297, 305, 306, 307, 311, 315, 319, 323, 327, 330, 360, 361, 362, 433, 443, 596, 599, 601, 606, 613, 621, 787, 792, 808, 815, 827, 828, 862, 975, 983, 1302 | 1S, 6S, 7S, 8S, 9S, 11S | 14/31(45.2) |
| 3     | 445, 451, 526, 527, 528, 531, 532 | 1F, 4S, 12S | 1/7(14.3) |
| 4     | 496, 513, 518, 464, 521, 523, 524, 525 | 3F, 5F, 9F | 1/8(12.5) |
| 5     | 210, 211, 292, 239, 456, 458, 460, 479, 796, 799, 805, 818 | 6F, 14F | 1/12(8.3) |
| 6     | 530 | 7F, 12F, 10F | 1/3(100) |
| 7     | 785 | . | 0/0 |
| 8     | 331, 333, 347, 349 | 2F, 8F, 10S | 1/4(25) |
| 9     | 784, 790 | 2S | 0/0 |
| 10    | 484, 519, 977 | 16F | 0/3 |

*S/Roads: Occurrence of snatch/total number of roads

**Reason for feeling insecure/secure ID: See table 4.5

5.2 Road length/width

Group 2, which has a high rate of snatch occurrences and a high feeling of security, has the longest (85 m, average: 63 m) and widest roads (14.4 m, average: 10.6 m) among the groups. This might mean that when the roads are long and wide, people feel secure even though the rate of snatch occurrences is high. In the case of group 4, which has a low rate of snatch occurrences and a high feeling of insecurity, it has the shortest (34.9 m) and narrowest roads (4.7 m) among the groups (Table 9.).

| Group | Average of road length (m) | Average of road width (m) | S/Roads* |
|-------|---------------------------|--------------------------|----------|
| 1     | 60.8                      | 14.5                     | 0.2      |
| 2     | 85.0                      | 14.4                     | 0.5      |
| 3     | 38.9                      | 6.0                      | 0.1      |
| 4     | 34.9                      | 4.7                      | 0.1      |
| 5     | 49.9                      | 6.8                      | 0.1      |
| 6     | 18.3                      | 5.8                      | 1.0      |
| 7     | 73.4                      | 6.9                      | 0/1      |
| 8     | 56.3                      | 9.1                      | 0.3      |
| 9     | 84.0                      | 6.0                      | 0/2      |
| 10    | 36.2                      | 3.5                      | 0/3      |

Average each road: 63.0, 10.6, 22/83

*S/Roads: Occurrence of snatch/total number of roads

5.4 Building use

Groups 4 and 5 have the largest percentage of houses (65.5% and 62.5%, respectively) and 3.4% and 16.1% of the local shops, respectively. However, the respondents feel insecure concerning snatch. Group 2 comprises 45.6% of the shops and 20.8% of the houses, respectively (Table 11.).

5.5 Open space/parking lots

Group 2 has a larger number of open spaces/parking lots than any other group. However, the ratio of the length of the open spaces and the road length is 0.11, which is the smallest among all the groups (excluding Groups 6 and 10, since these groups do not have open spaces or parking lots). In the case of groups 4 and 5, this ratio is 0.49 and 0.35, respectively, which is higher than that of any other group. This might imply that this ratio is more important than the number of open spaces/parking lots with regard to developing feelings of insecurity/security toward snatch. High ratios increase the feelings of insecurity on safe roads (Table 12.).

6. Implications/Conclusion

In this study, by using a correspondence analysis, the authors first tried to assess the relationship between snatch occurrences and the reasons for harboring feelings of security/insecurity concerning snatch. Next, they analyzed the characteristics of the roads in a
Table 11. Building Use

| Use of buildings | Group 1 | Group 2 | Group 3 | Group 4 | Group 5 | Group 6 | Group 7 | Group 8 | Group 9 | Group 10 | Total |
|------------------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|-------|
| (S/Roads*)       | 3/14    | 14/31   | 1/7     | 1/8     | 1/12    | 1/1    | 1/1     | 1/4     | 1/4     | 0/2     | 0/3   |
| Detached house   | 19(26.7)| 47(20.8)| 12(46.2)| 19(65.5)| 35(62.5)| 2(66.7)| -       | 8(50)   | 4(44.4) | 7(50)   | 153(33.8) |
| Store            | 35(49.3)| 103(45.6)| 4(15.4)| 1(3.4)  | 9(16.1) | -       | -       | 7(43.8)| 0(0.0)  | 4(28.6) | 163(36.1) |
| Apartment        | 3(4.2)  | 17(7.5) | -       | 3(10.3)| 3(5.4)  | -       | 1(50)   | -       | 2(22.2) | 2(14.3) | 31(6.9)  |
| Factory          | -       | 1(0.4)  | 4(15.4) | -       | 4(7.1)  | -       | -       | 1(11.1) | -       | 10(2.2) | 8(1.8)   |
| Public facility  | 1(1.4)  | 4(1.8)  | -       | 2(6.9)  | -       | -       | -       | 1(6.3)  | -       | -       | 8(1.8)   |
| Walk-up building | -       | 7(3.1)  | -       | -       | -       | -       | -       | -       | -       | -       | 7(1.5)   |
| High-rise building| 7(9.96) | 35(15.5)| 1(3.8)  | -       | -       | -       | 1(50)   | 1(11.1) | -       | -       | 45(10.0) |
| Hospital         | 2(2.8)  | 6(2.7)  | -       | -       | -       | -       | -       | -       | -       | -       | 8(1.8)   |
| Warehouse        | 4(5.69) | 6(2.7)  | 5(19.2) | 4(13.8)| 5(8.9)  | 1(33.3)| -       | 1(11.1) | 9(64.3) | -       | 27(6.0)  |
| Total            | 71(100) | 226(100)| 28(100) | 29(100)| 56(100) | 3(100) | 2(100)  | 16(100) | 9(100)  | 14(100) | 452(100) |

Table 12. Open Space/Parking Lots

| Group       | Number of open spaces facing the road | Average area of open spaces (m2) | Average length of the open spaces facing the road (m) | Length of open spaces/length of road | S/Roads* |
|-------------|---------------------------------------|----------------------------------|---------------------------------------------|----------------------------------|---------|
| 1           | 16                                    | 245.6                            | 12.2                                        | 0.20                             | 3/14    |
| 2           | 38                                    | 264.4                            | 10.4                                        | 0.11                             | 14/31   |
| 3           | 8                                     | 225.3                            | 12.3                                        | 0.32                             | 1/7     |
| 4           | 5                                     | 469.5                            | 19.2                                        | 0.49                             | 1/8     |
| 5           | 7                                     | 916.9                            | 16.8                                        | 0.35                             | 1/12    |
| 6           | 0                                     | 0.0                              | 0.0                                         | 0.00                             | 1/1     |
| 7           | 1                                     | 66.6                             | 19.6                                        | 0.27                             | 0/1     |
| 8           | 1                                     | 49.9                             | 10.3                                        | 0.22                             | 1/4     |
| 9           | 1                                     | 526.8                            | 14.3                                        | 0.27                             | 0/2     |
| 10          | 0                                     | 0.0                              | 0.0                                         | 0.00                             | 0/3     |

*S/Roads: Occurrence of snatch/total number of roads

target area, which they divided into 10 groups by using the k-means clustering method. The results can be summarized as follows:

1) Group 2 presents the highest rate of snatch occurrences (45.2%) and feelings of security (clear view of approaching people; high traffic roads; use of buildings — ground floors used as convenience stores and factories; no open spaces, such as parking lots or parks; well-separated sidewalks and driveways; people walking on a separate portion of the road with no obstructions), implying that individuals feel an unreasonable sense of security on unsafe roads. The roads in this group are characterized by the largest percentage of shops (65.5%) and houses (62.5%), the longest roads, largest sidewalks, and the lowest ratio of the length of open spaces/parking lots to the road length.

2) Groups 4 and 5 present low rates of snatch occurrences (12.5% and 8.3%, respectively); however, individuals harbor an unreasonable sense of insecurity (irregular occurrence of passersby, bad visibility, low traffic roads, condition of the sidewalk, knowledge about incidents that occurred (memory)) on safe roads. The roads in these groups are characterized by the largest percentage of houses (65.5% and 62.5%, respectively) followed by shops, shorter roads than the average in the target area (34.9 m and 49.9 m, respectively), not many sidewalks, and the highest ratio of length of open spaces/parking lots to the road length.

3) In groups 1, 3, and 8, the reasons for feelings of insecurity/security coexist. Group 6 has only one road but three reasons for feeling insecure about it (use of buildings with convenience stores and factories on the ground floors, signs for security advisories, and buildings with windows and balconies that do not face the street). Group 9 has only two roads but the respondents feel secure (no people standing idly on the roadside) on the safe roads. The main conclusions of this study are that, predominantly, there is a lack of correspondence between the degree of security about the roads analyzed and the sense of security among the interviewed individuals. People feel secure on roads with a high rate of snatch occurrences and, conversely, they feel unreasonably insecure on roads with a low rate of snatch occurrences. In general, it seems that individuals feel secure on roads that have been subjected to land readjustment projects, and on main roads having a high rate of snatch occurrences. Conversely, individuals feel insecure on safe roads that have not been subjected to land readjustment projects and are curved. Additionally, in general, it seems that the longer the road, the more secure individuals feel about it. It also appears that individuals feel secure when roads have sidewalks. Regarding the open space/road length ratio, it can be concluded that, in general, the smaller the ratio, the more secure individuals feel about the road. Finally, findings should be shared not only with the individuals currently living in the area analyzed but also with individuals living in areas with similar characteristics, in order to reduce the unreasonable sense of security on unsafe roads and the unreasonable sense of insecurity on safe roads.

7. Limitations and Further Research

To analyze the relationship between insecurity about snatch and safe and unsafe places, this study used the correspondence analysis method. Valuable conclusions can be drawn from the authors’ work. Furthermore, they believe that the outcome can be enhanced by gathering more data (such as omni-directional images) and by applying a statistical method that might also
allow the assessment of the correlation effect between snatch occurrences and the reasons why people develop secure/insecure feelings toward snatching. The authors will certainly direct their further research toward this.

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Notes
1 A road is defined as the area between two intersections, and a road that bends more than 30 degrees is considered to be two different roads.
2 Calculated from the city statistical data (as of October 2008).
3 References 13) and 14) make use of the total number of roads (988) collected.
4 Open spaces include parks and empty spaces left on the site and bearing no construction, excluding gardens and parking spaces in the paths of houses.

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