Are Children Safe from Crime?: Focusing on Streets in Elementary School Zones

Gidong Byun1 and Mikyoung Ha*2

1Ph.D., Department of Interior Architecture and Built Environment, Yonsei University, Korea
2Professor, Department of Interior Architecture and Built Environment, Yonsei University, Korea

Abstract
The objective of this study was to determine street environments wherein fear of crime and actual crime are highest in the environments surrounding elementary schools. To achieve this objective, elementary students' fear of crime and actual crime experienced were analyzed. The study adopted a geographical method based on streets. The study results were as follows. First, a large number of elementary students experienced fear of crime on the road at the school they attended. Female students feared crime more than male students. Second, students' fear of crime was mainly attributed to human factors (Many Bullies, Few People). Third, most elementary students experienced a fear of crime within a certain distance (500 m) from the school. Fourth, fear of crime and actual crime occurred mainly in small streets, small parks, or middle or high schools (advanced schools) nearby. Fifth, fear of crime and actual crime occurred near geographically similar elementary schools. Sixth, elementary students primarily experienced a fear of crime and actual crime on streets in densely populated residential areas.

Keywords: fear of crime; actual crime; school crime; GIS; spatial analysis

1. Introduction
1.1 Background
Adolescence provides people with the foundation for managing their lives as a member of human society. In particular, the elementary school period is important because this is when students first enter society away from the protection of their families. However, elementary students are still physically and mentally immature, making them vulnerable to societal stimuli. Specifically, experiences like crime can negatively influence them throughout their lives.

Recent years have witnessed an increasing crime rate in metropolitan cities. Particularly, recent city crimes increasingly target younger age groups, and various crimes are now evident. With regard to crime against elementary students, the Police Affairs Bureau, Republic of Korea Police reported 902 cases in 2000. This figure increased 3.3 times to 2,974 cases in 2010. Furthermore, 42.8% of crimes are committed on the street, 5.5% in detached houses, 5.1% in drinking and entertainment areas, 4.5% in apartments, and 3.5% in shops (2012 Analytical Report on Crime, Supreme Public Prosecutor's Office, 2012). This data indicates a large number of crimes committed on streets and in residential areas. Thus, elementary students are at increasing risk because most are confined to a specific school range primarily connecting the school they attend and their homes. In addition, most walk on streets (Sugihara et al., 2010). Previous studies indicate the negative effects of constant exposure to social crimes on adolescents' development and adaptability (Attar & Guerra, 1994; Fitzpatrick & Boldizar, 1993; Jenkins & Bell, 1994; Martinez & Richters, 1993). Moreover, fear of crime is closely related to physical vulnerability (MIRRLEES-BLACK et al., 1996). In particular, elementary students' fear of crime is closely related to the road surrounding their schools (WIEBE et al., 2013). The relationship between fear of crime and actual crime varied according to researchers. Some researchers reported that crime experience can reduce the level of fear of crime (SPARKS, Genn, and Dodd, 1977), whereas another researcher claimed that recognition of possible crime victimization increased the fear of crime (WYANT, 2008). Some study results indicated that the pattern of occurrence of crime-related anxiety was different from the pattern of occurrence of crime (DUBOW et al., 1979; MAXFIELD, 1987), and some study results proposed that women and the elderly had a high level of crime-related anxiety but that criminal victimization among them was actually low (STAFFORD & GALLE, 1984). Therefore, to guarantee the sound development of elementary students, street environments nearby schools where they experience a fear of crime or actual crime must be analyzed.

*Contact Author: Mikyoung Ha, Professor, Department of Interior Architecture and Built Environment, Yonsei University, 417 Samsung Hall 134 Sinchon-Dong, Seodaemun-Gu, Seoul, 120-749 Korea Tel: +82-2-2123-3135 Fax: +82-2-2123-8662 E-mail: mkha@yonsei.ac.kr
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1.2 Objectives

The objective of this study was to determine the street environments nearby elementary schools where fear of crime and actual crime are experienced to propose directions for improvement. As a result, this study aims to provide an environment that can positively affect the physical and mental development of elementary students. To achieve these goals, the following detailed objectives were formulated and implemented. The objectives of this study are to: 1) Analyze elementary students’ experiences of fear of crime and actual crime, 2) analyze elementary students’ experiences of fear of crime and actual crime according to the pedestrian environment, 3) analyze the relationship between elementary students’ fear of crime and actual crime and street characteristics, and 4) using geographical analysis, analyze the environmental characteristics of fear of crime and actual crime. The above analyses enables an analysis of the crime risk level near elementary schools, and thus a measure to improve crime-related safety nearby elementary schools is presented.

2. Methodology

2.1 Elementary School Site Criteria

The most important consideration for selecting elementary schools is the appropriate distance to the schools that the students attend. Distance to the elementary school attended has been a major factor in determining the size of residential complexes since Perry (1929) proposed the "Neighborhood Theory". Since then, many urban planning theorists (Stein, Sert, Engelhart) have proposed a residential complex planning theory on the basis of elementary schools. As a location-related rule for elementary schools, urban planning theories recommend a distance of 400–800 m between residential areas and elementary schools. In Korea, an "Urban Planning Act" regulation has set the "distance to the elementary school attended" to within 1,000 m (1 km). However, the actual distance to the school differs depending on residential density or the number of attending students. Furthermore, since city configuration has become more complex, distance to the school attended is not uniformly applied. To resolve this issue, the local Office of Education in Korea designated a "school district" considering the maximum applicable number of attending students and school distance.

2.2 School Selection

Target elementary schools were selected for this study based on four criteria: 1) Number of crime occurrences in a district, 2) number of elementary schools in a district, 3) number of elementary students in a district, and 4) number of school bullying incidents in a district. These criteria were formulated to select a district with a higher risk of crime exposure than other districts. Based on these criteria, Songpa-gu district was chosen as the study area among 25 districts in Seoul City. In Songpa-gu, 10.72 cases of crime per 1,000 persons (6.82 persons per 25 households on average) were reported, the number of elementary schools is 37 schools (23.64 schools per 25 households), the number of elementary students is 38,315 students (21,437 students per 25 households on average), and 1,114 school bullying incidents (553.40 incidents per 25 households on average) were reported. Of the 37 elementary schools in Songpa-gu, study target areas were selected based on residential building type within the school district of each elementary school. Residential building type can be classified as low-rise residential building areas, high-rise residential building areas, and mixed areas comprising low- and high-rise buildings. In this study, high-rise residential building areas were excluded, and two districts, one in a low-rise residential building area and one in a mixed area comprising low- and high-rise buildings, were selected. High-rise residential buildings were excluded because this study is based on streets, and high-rise residential buildings are usually large, complex-based buildings with streets inside the residential complex. These complexes restrict access by outsiders, meaning that only complex residents have access. Thus, the street environment differs from that in other city areas, which can be freely accessed by an unspecified number of pedestrians.

Table 1. Major Features of Selected School Districts

| Criteria                        | District A | District B | District C | District D |
|---------------------------------|------------|------------|------------|------------|
| Number of classes               | 54         | 38         | 46         | 44         |
| Number of students              | 1,417      | 1,028      | 1,280      | 1,282      |
| Area of school districts (m²)    | 764,858    | 757,129    | 638,713    | 467,399    |
| OSHP (USD/m²) a                   | 3,000      | 2,900      | 3,700      | 3,900      |
| OSLP (USD/m²) a                   | 3,400      | 4,000      | 6,400      | 6,100      |
| Children population ratio (%)    | 10.6       | 9.0        | 12.7       | 14.6       |
| OSHP: Official Standard Land Price|            |            |            |            |
| OSLP: Official Standard Housing Price|          |            |            |            |

a: These are officially announced prices of houses and land adjacent to the target school, provided by the Ministry of Land, Infrastructure and Transport as of Sep. 2016.

2.3 Data Collection

A survey was conducted on elementary students in the fifth and sixth grades, as these students are able to understand crime-related experiences (Salmon et al., 1998). Students in lower grades were excluded because they may have difficulty in understanding spaces and communicating about "crime" or "fear". To geographically analyze fear of crime, this study used maps of the target districts. This type of survey was conducted because without maps, a general survey, while obtaining an overall understanding, cannot disclose detailed information about fear of crime and actual crime in target districts. The following survey procedure was implemented. First, surveyed students' attending school roads were indicated on the map to create a geographical image of the district. Then, students wrote about where they experienced a "fear of crime," the reason, where actual crime was experienced, and details of the crime.
The number of total respondents was 322 students (A-82, B-77, C-85, and D-78). Of these, 3 responses deemed insincere were excluded, leaving 319 responses for analysis in this study. The survey period was November 2012 to February 2013.

2.4 Street Environment
This study aimed to geographically analyze elementary students' experiences of fear of crime and actual crime in the street environment. Thus, street environments in the school districts of target elementary schools designated by the local Office of Education were studied. First, target streets were separated into individual streets based on crossing streets. For example, if a straight street crossed another street, both streets were selected as an individual street.

Then, intersected streets were divided by the cross into a unit street as shown in Fig.1. Finally, the street environment of individual streets was studied. The street environment was analyzed based on the width of the street, distance from the main gate of the elementary school, location of parks and advanced schools, and use of building structures adjacent to the streets.

3. General Description
3.1 Target Area
The characteristics of elementary school districts are as follows (Table 2.). First, the distance between the center of the school district and main entrance of the school by shortest distance was D (26.06 m), B (27.69 m), A (169.20 m), and C (497.94 m). Three schools, except for C, were closely located to the center of the school district. Second, with regard to the layout of streets, A's streets cross in south-north and east-west directions, similar to the direction of the boundary of the school district. In the cases of B, C, and D, the irregular layout and non-specific street direction mirror that of the school district. In the cases of B, C, and D, the irregular layout and non-specific street direction mirror that of the school district. Third, residential building layout is as follows: A and B are densely populated with low-rise buildings, while C and D are mixed with low- and high-rise residential building complexes. Fourth, the layout of non-residential buildings is as follows: A, non-residential buildings are along the road in a south-north direction, while B has non-residential buildings primarily in a north direction. In contrast, C and D are characterized by fewer non-residential buildings, although these are distributed over a larger area. Fifth, the park area is distributed over low-rise residential building areas. Specifically, A and B have mid-size parks near the schools. Sixth, advanced schools are distributed within the school district as follows: Areas A, C, and D have advanced schools, while C has three advanced schools in the same school district. In areas C and D, advanced schools are located adjacent to the elementary schools.

| Table 2. Target Area |
|---------------------|
| A                   |
| B                   |
| C                   |
| D                   |

3.2 Elementary Students' Transportation and Crime
Gender, transportation to school and home, and companions were surveyed as a general item (Table 3.). Walking was the primary means of transportation for responding elementary students. A total of 215 (67.4%) students commuted with parents or friends. A t-test determined the statistical difference of fear of crime and actual crime by commuting type. The test indicated a significant difference only in fear of crime experienced by gender (male: mean = 0.70, Std. Deviation = 0.460, female: mean = 0.84, Std. Deviation = 0.371, df = 304.220, t = -2.919, p = 0.04).

| Table 3. Gender and Transportation |
|-----------------------------------|
| Gender                           |
| Male                             |
| Female                           |
| Transportation to school         |
| Male                             |
| Female                           |
| Transportation to home           |
| Male                             |
| Female                           |
| Companions                       |
| Alone                            |
| Together                         |
4. Geographical Analysis

4.1 Fear of Crime and Actual Crime

A total of 245 elementary students (76.8%) experienced a fear of crime. Of these, 152 elementary students (47.65%) experienced a "fear of crime on the way to school and home." The number of students who experienced actual crime was 76 students (23.82%). Among them, 29 students (9.09%) "experienced an actual crime on the way to school and home." These results indicate that a large number of elementary students experienced a fear of crime in daily life on the way to school and home regardless of actual crime experienced (Table 4).

Table 4. Fear of Crime and Actual Crime (n = 319)

| Fear of Crime | A | B | C | D | Total |
|---------------|---|---|---|---|-------|
| Yes           | 74(23.20) | 93(29.15) | 152(47.65) | 245(76.80) | 319(100.00) |
| No            | 13(48.15) | 1(5.88) | 16(19.28) | 34(23.61) | 74(23.20) |

The number of students who experienced "fear of crime" and "actual crime" occurring on streets, while the school district. With regard to types of fear, 43 cases (51.81%) involved "Violence and property," 17 cases (20.48%) involved "Outcasts," and 5 (6.02%) were "Sexual crime" cases. In addition, there were 2 cases (2.41%) of "Complex crime" and 16 (19.28%) "Other" cases (Table 6.). For "Other" responses, most students reported being "approached by a stranger." This relates to the recent prevalence of child-related crimes in Korea. Consequently, to prevent this social risk, children have been educated to reject any request from strangers if they are approached, regardless of intention.

Table 5. Reasons for Fear of Crime in School Districts (n = 580)

| Reason for Fear of Crime | A | B | C | D | Total |
|--------------------------|---|---|---|---|-------|
| Few people               | 14(10.94) | 34(23.61) | 34(23.61) | 33(23.40) | 105(18.10) |
| Many bullies             | 33(25.78) | 33(25.78) | 36(25.53) | 200(34.48) | 395(68.87) |
| Darkness                 | 39(30.47) | 28(19.44) | 9(5.39) | 23(16.31) | 99(17.07) |
| Waste and Graffiti       | 3(2.34) | 4(2.78) | 4(2.78) | 13(2.24) | 24(4.14) |
| No security guard        | 0(0.00) | 0(0.00) | 0(0.00) | 0(0.00) | 0(0.00) |
| Complex causes           | 11(8.59) | 12(8.33) | 15(9.88) | 19(13.48) | 57(9.83) |
| Other                    | 28(21.88) | 31(21.53) | 15(9.88) | 28(19.86) | 107(18.95) |
| Total                    | 128(100.00) | 44(100.00) | 67(100.00) | 141(100.00) | 319(100.00) |

The total number of cases of surveyed students who experienced a fear of crime was 624. Of these, in 580 cases (92.95%), a fear of crime was experienced within the school district. With regard to reason for fear, results indicated that 200 cases (34.48%) were attributed to "Many bullies," 105 cases (18.10%) to "Few people," 99 cases (17.07%) to "Darkness," 13 cases (2.42%) to "Waste and graffiti," and 4 cases (0.69%) to "No security guard." In addition, 57 cases (9.83%) were attributed to "Complex causes," and 102 cases (17.59%) to "Other". These results primarily attribute elementary students' fear of crime to human factors (Few People, Many Bullies) rather than spatial factors (Darkness, Waste, and Graffiti), which is consistent with the results of previous studies (Lee et al., 2012). However, fear of crime due to human factors showed contrasting characteristics. For example, in cases in areas with more people, concerns over the high potential of crime created a fear of crime. On the other hand, only a vague fear of crime was evident in areas with fewer people. For "Other", 30 cases were attributed "because of a small alley" and it "just felt spooky" (29.41%), indicating that elementary students' fear of crime largely depended on an anxiety regarding spaces. Also in the "Other" category, "drinker or smoker found" and "vehicle congestion" accounted for 24 cases (23.53%). Here, a fear of crime was triggered in situations where elementary students experienced harmful stimuli in the social context.

Next, 87 cases of actual crime were experienced. Of these, 83 actual crimes occurred within school districts, accounting for 95.40% (Table 6.). With regard to types of crime, 43 cases (51.81%) involved "Violence and property," 17 cases (20.48%) involved "Outcasts," and 5 (6.02%) were "Sexual crime" cases. In addition, there were 2 cases (2.41%) of "Complex crime" and 16 (19.28%) "Other" cases (Table 6.). For "Other" responses, most students reported being "approached by a stranger." This relates to the recent prevalence of child-related crimes in Korea. Consequently, to prevent this social risk, children have been educated to reject any request from strangers if they are approached, regardless of intention.

Table 6. Types of Actual Crime in School Districts (n = 83)

| Type of Crime | A | B | C | D | Total |
|---------------|---|---|---|---|-------|
| Violence/Property | 12(60.00) | 8(47.06) | 13(48.15) | 10(52.63) | 43(51.81) |
| Outcasts      | 2(10.00) | 1(5.88) | 9(33.33) | 5(26.32) | 17(20.48) |
| Sexual        | 2(10.00) | 3(17.65) | 0(0.00) | 0(0.00) | 5(6.02) |
| Complex Crime | 2(10.00) | 0(0.00) | 0(0.00) | 0(0.00) | 2(2.41) |
| Other         | 2(10.00) | 5(29.41) | 1(5.39) | 4(21.05) | 16(19.28) |
| Total         | 20(100.00) | 17(100.00) | 9(100.00) | 9(100.00) | 57(100.00) |

Next, fear of crime and actual crime were geographically analyzed (Table 7.). Based on the distance from elementary school criterion, 516 cases (88.97%) of "fear of crime" and 68 cases (11.03%) of "actual crime" occurred within 500 m of schools. A previous study indicated the trajectory of walking elementary students within the school district (Sughara et al., 2010). In the present study, results by target district were as follows. For fear of crime, 140 cases (99.29%) in D, 127 cases (99.22%) in A, 137 cases (95.14%) in B, and 112 cases (99.22%) in C were found. For actual crime, 20 cases (100%) in D, 19 cases (100%) in A, 16 cases (94.12%) in B, and 13 cases (48.15%) in C were indicated. Fear of crime and actual crime in the C District, which is quite far from the elementary school, occurred because the elementary school is located on the outskirts of the school district.

In addition, locations where fear of crime and actual crime occurred can be categorized as "point element" or "plane element." The "point element" refers to fear of crime and actual crime occurring on streets, while...
"plane element" refers to fear of crime and actual crime in specific spaces such as buildings or parks. The following results were obtained for types of streets and spaces. First, for fear of crime, there were 463 cases (79.83%) of "point element" and 117 cases (20.17%) of "plane element." Depending on the width of the street, the plane element was then subdivided into 343 cases (59.14%) in "S3," 43 cases (7.41%) in "S2," 35 cases (6.03%) in "M2," and 21 cases (3.62%) in "L." The plane element was also subdivided: 56 cases (9.66%) in "small park," 37 cases (6.38%) in "children's park," and 9 cases (1.55%) in "apartment complex." Next, with regard to actual crime, 63 cases (75.90%) of "point element" and 20 cases (24.10%) of "plane element" were found. For the plane element, 41 cases (49.40%) were within "S3," 9 cases (10.84%) in "M3," 7 cases (8.43%) in "S2." For the plane element, 12 cases (12.77%) occurred in a "small park," 11 cases (11.70%) at the "advanced school," 2 cases (2.13%) at the "apartment complex," and 2 cases (2.13%) at the "community facility." Previous studies noted that serious crimes occur more often on small roads because they narrow the field of vision and passage fewer people (Simon, 2008). In addition, less danger may be recognized in parks because of hidden spaces behind many trees (Murota, 2009). Therefore, these results indicate that fear of crime and actual crime occurred mainly on small roads measuring less than 8 m wide, in small parks, or near advanced schools.

### 4.2 Density Analysis of Fear of Crime and Actual Crime

Arcgis 9.3 was employed to analyze fear of crime and actual crime geographically (Table 8.). Density analysis is a method that expresses the intensity of occurrence of a possible event through events (e.g., actual crime, fear of crime) observed in the district (Anselin et al., 2000). Thus, it is necessary to identify the place where either actual crime or fear of crime is experienced strongly as well as the place where both events are strongly experienced simultaneously in order to set the direction of environmental improvements and policy executions. The analysis procedure was as follows: 1) Kernel density analysis was conducted on places where fear of crime and actual crime were experienced. 2) Frequencies of fear of crime and actual crime on streets were classified with neutral breaks and overlapped to represent them on the density map. 3) Density of non-residential buildings in school districts was analyzed. 4) In each step, locations of parks and advanced schools in the school district were marked. The analysis yielded the following results.

First, A District showed that locations of fear of crime and actual crime were distributed similarly. Fear of crime and actual crime heightened within a short distance of elementary schools. In addition, the park location was geographically highly dense. Places where fear of crime occurred many times were on winding roads near the school (A-2, A-3) and roads adjacent to the park (A-1) (Table 9.). Next, the direction of streets where fear of crime occurred differed from that at non-residential

### Table 7. Places where Fear of Crime and Actual Crime were Experienced

| Distance from Entrance of School | FC: n=580, AC: n=83 |
|---------------------------------|---------------------|
| SL: W ≥ 40 m                   |                     |
| M1: 300 m                      |                     |
| M2: 200 m                      |                     |
| M3: 100 m                      |                     |
| S1: 500 m                      |                     |
| S2: 400 m                      |                     |
| S3: 300 m                      |                     |
| Total                          |                     |

| Plan (On Facility) | FC: Fear of Crime | AC: Actual Crime |
|-------------------|-------------------|------------------|
| Mini-park         | 28(21.88)         | 30(22.98)        |
| Children's Park   | 0(0.00)           | 0(0.00)          |
| Neighborhood Park | 0(0.00)           | 0(0.00)          |
| Advanced School   | 2(1.56)           | 37(26.25)        |
| Apartment District| 1(0.78)           | 14(10.14)        |
| Commercial Facility| 0(0.00)       | 167(12.56)       |
| Community Facility| 2(1.56)           | 5(3.61)          |
| Subtotal          | 33(25.78)         | 16(12.17)        |

| Total             | FC: n=580         | AC: n=83         |
|-------------------|-------------------|------------------|
| Over 500 m        | 129(100.00)       | 141(100.00)      |
| 300 m             | 126(100.00)       | 141(100.00)      |
| 200 m             | 125(100.00)       | 141(100.00)      |
| 100 m             | 124(100.00)       | 141(100.00)      |
| Total             | 578(124.00)       | 683(100.00)      |

### Table 8. Places where Fear of Crime and Actual Crime were Experienced

| Point (On Street) | SL: W ≥ 40 m | M1: 300 m | M2: 200 m | M3: 100 m | S1: 500 m | S2: 400 m | S3: 300 m | Total |
|------------------|-------------|-----------|-----------|-----------|-----------|-----------|-----------|-------|
| FC: Fear of Crime|             |           |           |           |           |           |           |       |
| AC: Actual Crime |             |           |           |           |           |           |           |       |

### Table 9. Summary of fear of crime and actual crime

- First, A District showed that locations of fear of crime and actual crime were distributed similarly. Fear of crime and actual crime heightened within a short distance of elementary schools.
- In addition, the park location was geographically highly dense. Places where fear of crime occurred many times were on winding roads near the school (A-2, A-3) and roads adjacent to the park (A-1).
- Next, the direction of streets where fear of crime occurred differed from that at non-residential.
Table 8. Densities for Fear of Crime, Actual Crime, and Non-residential Buildings

| Density of Fear of Crime | Density of Fear of Crime | Density of Fear of Crime | Density of Fear of Crime |
|--------------------------|--------------------------|--------------------------|--------------------------|
| A                        | B                        | C                        | D                        |
| High                     | Low                      | High                     | Low                      |
| Fear of Crime : 4-5       | Fear of Crime : 6-8       | Fear of Crime : 8-13      | Fear of Crime : 8-19      |
| Fear of Crime : 3         | Fear of Crime : 4-5       | Fear of Crime : 4-7       | Fear of Crime : 4-8       |
| Fear of Crime : 2         | Fear of Crime : 2-3       | Fear of Crime : 2-3       | Fear of Crime : 2-4       |

| Density of Actual Crime | Density of Actual Crime | Density of Actual Crime | Density of Actual Crime |
|-------------------------|-------------------------|-------------------------|-------------------------|
| A                       | B                       | C                       | D                       |
| High                    | Low                     | High                    | Low                     |
| Actual Crime : 2        | Actual Crime : 2-8      | Actual Crime : 3-5      |

| Density of NRB | Density of NRB | Density of NRB | Density of NRB |
|---------------|---------------|---------------|---------------|
| A             | B             | C             | D             |
| High          | Low           | High          | Low           |
| X Main Entrance of School | NRB Non-residential Buildings | Park | Advanced School |

Table 9. Views of Criminal Hot Spots on Street

| Photo_A-1 | Photo_A-2 | Photo_A-3 | Photo_B-1 | Photo_B-2 |
|-----------|-----------|-----------|-----------|-----------|
|           |           |           |           |           |
| Photo_C-1 | Photo_D-1 | Photo_D-2 | Photo_D-3 |           |
buildings. In addition, although there was an advanced school in the school district of A District, less fear of crime or actual crime was experienced because the school and advanced school were located quite far apart.

Second, similar to A District, results indicated that in B District, a large number of fear of crime and actual crime experiences occurred within a certain distance of the school. In addition, the park location exhibited a higher density of fear of crime and actual crime. Streets with many fear of crime experiences were small roads at the back and side of the school wall (B-1, B-2). The roads were quite dark here because of the blocked school wall and high structure of the school building (Table 9.). Although non-residential buildings near the school in B District were densely populated, there were fewer experiences of fear of crime or actual crime.

Third, in C District, the corresponding elementary school was located in the lower end of the school district; thus, densities for fear of crime or actual crime did not reflect a radial shape. However, experiences occurred primarily in the park area and adjacent to advanced schools. The street triggering the highest number of fear of crime experiences was a road (C-1) passing through two high-rise residential building complexes (Table 9.). Furthermore, non-residential buildings were distributed irregularly; thus, a relationship with fear of crime or actual crime is unclear.

Fourth, in D District, fear of crime and actual crime were experienced in the high-rise residential complex adjacent to the southwest of the school. Moreover, this district showed a lower correlation with parks in contrast to other districts, because students' activities in the high-rise residential complex mainly occurred inside the complex after school. Thus, fear of crime was high on the streets (D-2, D-3) adjacent to the high-rise building complex (Table 9.). Similar to C District, an irregular distribution of non-residential buildings in D District was evident.

Overall results of the analysis indicate that streets near the elementary school where fear of crime was high were small roads located on the side and back adjacent to the school. Such streets have no boundary between traffic and sidewalks, and part of the road was used as a parking space. Further characteristics of these roads include that they are long with fewer branches. In addition, fear of crime was high in roads adjacent to the high-rise residential complex, and fear of crime or actual crime was high near the advanced school or small parks within the school district. However, a negative correlation was evident depending on distance to the elementary school. Fear of crime was also higher on roads in residential areas than on those in non-residential areas, because residential area roads passage fewer people. In addition, a parking piloti was installed on the ground floor, which provides a hiding place for offenders.

5. Discussion

The objective of this study was to determine pedestrian environments wherein fear of crime and actual crime are highest in the environments surrounding elementary schools. The following results were obtained from the geographical method and survey.

First, a difference of fear of crime by gender was evident; female students had a higher fear of crime than male students. Our study result is similar to those of previous studies (Dubow et al., 1979; Lee et al., 2012). In addition, walking with companions such as friends or parents was the primary means of transportation to school and home. However, this type of commute was not statistically significant with regard to fear of crime and actual crime. Most respondents experienced fear of crime near elementary schools on the way to school and home.

Second, students' fear of crime was mostly attributed to human factors (Many Bullies, Few People). However, with regard to human factors, contradictory results indicate different reasons for this fear. This was because defensive actions against the occurrence of crime due to physical vulnerability (Many Bullies) and a preoccupation with a vague fear due to shared social perceptions (Few People) simultaneously impacted the experience of fear. The type of actual crime experienced was mainly "Violence and property." In addition, crimes related to "Outcasts" and "Sexual crimes" were found, although in lower proportions. The immaturity of elementary students makes these crimes dangerous; the trauma caused by these types of crimes negatively influences physical and mental growth. Thus, despite the small proportion of such crimes, social attention should focus on them.

Third, most elementary students' experiences of fear of crime occurred within a certain distance (500 m) of the school, because school districts were selected based on walking distance to school. In Korea, the "School Health Legal Provision" currently prohibits the installation of facilities harmful to adolescents within 200 m of elementary schools. However, the results of this study indicate that places where fear of crime and actual crime were experienced were related to the area of the elementary school's location in the school district. Thus, the legal provision currently applied in Korea should be flexible depending on elementary schools' geographic circumstances.

Fourth, fear of crime and actual crime were experienced mostly on small roads less than 8 m wide and near to small parks and advanced schools. Such small roads were located in areas where residential buildings were densely populated and traffic and sidewalks were not separated. In addition, there were "Residential Parking Blocks" to alleviate parking difficulties and piloti parking places installed. These installations lead to an uneven surface of the pedestrian environment, which increases non-visible areas, and thus the fear experienced by pedestrians. Furthermore, previous studies regarded small parks as important places for children (Min et al., 2006). However, the present study identified small parks as places where fear of crime and actual crime occurred most frequently. While elementary students frequent small parks, so do an unspecified number of other people. Therefore,
access control or monitoring of small parks is needed to protect children from adults or students in higher grades.

Fifth, in contrast to the results of previous studies, this study found that fear of crime and actual crime occurred in geographically similar elementary schools. In previous studies, fear of crime and actual crime were not closely correlated (Romer et al., 2003, Lee et al., 2012). In addition, a study on elderly people showed that places where fear of crime and actual crime occurred differed (An & Yoshida, 2011). However, according to the results of this study, places where fear of crime and actual crime occurred were similar geographically (although differences in frequency were found). Therefore, if places where crime is likely to occur are found by measuring the history of 911 calls, and security in these places is improved, then the psychological fear of crime will be reduced.

Sixth, elementary students experience fear of crime and actual crime mainly on streets in densely populated residential areas. In particular, it is uncommon that lower fear of crime and actual crime is experienced on roads adjacent to non-residential buildings where an unspecified number of people are frequently present. As such, non-residential buildings can more easily monitor streets than residential buildings, and can be used as evacuation spaces in the case of risk. This also complies with the CPTED principle. Recently, to improve the residential environment, opinions to oppose the indiscreet construction of non-residential buildings in residential areas have emerged. However, installation of non-residential buildings from where ground-floor monitoring can occur should be considered in terms of crime-related safety for elementary students.

6. Limitations and Further Research
The present study conducted a geographical analysis based on streets to determine crime-related safety near elementary schools. However, psychological determination of fear of crime could be affected by a city's three-dimensional environment (height of building structure, building screening rate, and ground-floor transparency). In the future, various physical factors over the environment will be studied to propose an empirically based crime-related safety environment for cities.

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Notes
1) The crimes analyzed in this study were limited to five major crimes (theft, murder, robbery, rape, and violence).
2) Applied the reference specified in the Ordinance of Ministry of Land, Infrastructure, and Transport in Korea.
3) Applied "Small Park," "Children's Park," and "Neighborhood Park" classified in the "Standards of installation and sizes for city parks."
4) The use of building structures is classified as residential and non-residential buildings.

References
1) An, J. & Yoshida, T. (2011) Use of Correspondence Analysis to Analyze Feelings of Insecurity Among the Elderly Concerning Snatch Occurrences on Roads. Journal of Asian Architecture and Building Engineering, 10 (1), pp.179-186.
2) Anselin, L., Cohen, J., Cook, D., Gorr, W., & Tita, G. (2000). Spatial analyses of crime. Criminal justice, 4(2), 213-262.
3) Attar, B. & Guerra, N. (Year) The effects of cumulative violence exposure on children living in urban neighborhoods. In: meeting of the American Psychological Society Convention, Washington, DC, 1994.
4) DuBow, F. et al. (1979) Reactions to crime: a critical review of the literature: executive summary, Department of Justice, Law Enforcement Assistance Administration, National Institute of Law Enforcement and Criminal Justice.
5) Fitzpatrick, K. M. & Boldizar, J. P. (1993) The Prevalence and Consequences of Exposure to Violence among African-American Youth. Journal of the American Academy of Child & Adolescent Psychiatry, 32 (2), pp.424-430.
6) Jenkins, E. J. & Bell, C. C. (1994) Violence among inner city high school students and post-traumatic stress disorder.
7) Lee, S. et al. (2012) Criminal spots on the way home from school a case study of middle schools in the Gangseo district. Journal of Asian Architecture and Building Engineering, 11 (1), pp.63-70.
8) Martinez, P. & Richters, J. (1993) The NIMH community violence project: II. Children's distress symptoms associated with violence exposure. Psychiatry, 56 (1), pp.22-35.
9) Maxfield, M. G. (1987). Incivilities and fear of crime in England and Wales and the United States: A comparative analysis. Paper presented at the Annual Meeting of the American Society of Criminology, Montreal.
10) Min, B. et al. (2006) Children's Behavioral and Conceived Domains in Neighborhood Environment. Journal of Asian Architecture and Building Engineering, 5 (1), pp.83-90.
11) Murota, M. (2009) A study on the use of parks in the Green Matrix System of Kohoku New Town, Japan -Focusing on parks Combined with pedestrian roads. Journal of Asian Architecture and Building Engineering, 8 (1), pp.73-79.
12) Perry, I. A. et al. (1929) Neighborhood and community planning, Regional plan of New York and its environs.
13) Romer, D. et al. (2003) Television news and the cultivation of fear of crime. Journal of Communication, 53 (1), pp.88-104.
14) Salmon, G. et al. (1998) Bullying in schools: self reported anxiety, depression, and self esteem in secondary school children. BMJ, 317 (7163), pp.924-925.
15) Simon, D. (2008) Homicide: A year on the killing streets, Canongate Books.
16) Sparks, R. F., Genn, H. G., & Dodd, D. J. (1977). Surveying victims: A study of the measurement of criminal victimization, perceptions of crime, and attitudes to criminal justice: Wiley London.
17) Sugihara, S. et al. (2010) Observations on Primary School Children's Behavior after School by Using the Global Positioning System. Journal of Asian Architecture and Building Engineering, 9 (1), pp.171-176.
18) Wiebe, D. J. et al. (2013) Fears of Violence During Morning Travel to School. Journal of Adolescent Health, 53 (1), pp.54-61.
19) Yant, B. R. (2008). Multilevel impacts of perceived incivilities and perceptions of crime risk on fear of crime isolating endogenous impacts. Journal of research in crime and delinquency, 45(1), pp.39-64.