

# Analyzing the Relationship between Citizen Report and Local Crime Occurrence Tendency Using Broken Windows Theory

Eiji Kano and Kazuhiko Tsuda

**Abstract**—Municipalities are required to prioritize and solve local problems effectively under human and financial constraints. Preventing local crime is an important challenge among them. One of the major theories of crime prevention is the “broken windows theory,” which states that if a minor crime or a rule infringement is left unaddressed, it may lead to more serious crimes. This theory affected police administrations in some areas, but it was not widely accepted due to problems such as difficulty in verifying its validity and identifying effective measures. There is a possibility that these limitations can be overcome by using data obtained from the citizen report system, which was introduced in municipalities in recent years. This study examines the relationship between local problems and local crimes based on the broken windows theory using citizen report data.

**Index Terms**—Broken windows theory, citizen report system, FixMyStreet, municipality, open data.

## I. INTRODUCTION

In recent years, the environment under municipality administration has become increasingly severe. While the municipalities are facing financial constraints as a result of decreasing tax revenue and increasing cost of social security due to an aging population, declining birthrate, and decreasing working-age population, the shortage of local administrative officers is a grave concern. Thus, municipalities are expected to resolve local problems based on their severity with limited human and budgetary resources.

One of the major crime prevention theories is the “broken windows theory,” proposed by Kelling [1]. This theory states that if a minor crime or a rule infringement is left unaddressed, it may give birth to more serious crimes. Various experimental activities have been conducted based on this theory; however, there are various limitations to it, such as difficulty in verifying the relationship between related events and crimes and identifying effective measures. In addition, several weaknesses regarding the procedures of the study were indicated [2].

Under such circumstances, the data obtained from the citizen report system, which was introduced in many municipalities in recent years, can be useful for grasping the problems occurring in the local community in a multifaceted and quantitative manner. The citizen report system is a quick, accurate, and easy-to-contact mechanism to approach the

municipality for local problems such as road damage, that are found by residents, with an image through the smartphone app. By classifying citizen reports sent from residents to municipality every day through this mechanism, it would become easier to identify what problems occur in which areas. Combining these data with the local crime data of each area, which have recently become accessible to the public by the prefectural police headquarters in Japan, should be able to clarify the relationship between local problems and local crime.

Thus, in this study, we analyzed the relationship between the number of citizen reports and the occurrence tendency of theft crimes, one of the major local crimes. If the existence of a relationship between the two are proved, it will be confirmed that the occurrence of local problems is related to the incidence of crime, as claimed in the broken windows theory. Moreover, if the relationship with crime for each specific problem type is found, it is possible to estimate which problem can be dealt with to obtain a high crime prevention effect. As a result, it would be possible to utilize citizen report for prioritizing the monitoring activities of local authorities and the police for preventing local crimes.

## II. POSSIBILITY TO UTILIZE CITIZEN REPORT DATA FOR CRIME PREVENTION

In the development of crime preventions theory, broken windows theory had raised expectations for a while. However, after that, because of the difficulty of verifying validity and identifying effective measures, the progress of the practice of and the study about the theory has not progressed very well. This chapter will show that the data obtained from the citizen report system can be a breakthrough for the stagnation.

### A. Study on Broken Windows Theory

Studies on clarifying the impact of local problems on crime occurrence originated in the theories developed in the 1970s, which regard the cause of crime to be in the physical environment [3]. They include the criminal opportunity theory, which insists that the environment induces crime [4] and the environmental determinism theory, which insists that crime is caused by physical environment [5].

In the development of criminal opportunity theory, as a theory that asserts that local problems affect crime, along with Hunter’s theory [6] that states that the devastation of the local environment affects crime anxiety, the broken windows theory was developed. This theory originated from an experiment by Zimbardo who watched the reaction when the window of a car was a little broken and was left as it were [7].

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This condition became a symbol of not paying attention in time, and all other windows were soon destroyed. The theory was named after this incident.

The theory also had a major impact on police administrations. In New York City, significant effects of reducing the crime rate were reported as a result of thorough enforcement of the theory on local problems such as graffiti and illegal parking. Based on the same theory, activities such as patrols in Adachi Ward, were carried out in Japan [8].

Studies have been conducted to verify the detailed components of the broken windows theory, for example:

- 1) the opinion of residents about the orderliness and cleanliness of their city affects the citizens' concerns about safety [9];
- 2) incidents of disorder had a significant impact on perceptions of disorder, while perceptions of disorder tend to increase fear for personal safety, which in turn reduces sense of collective efficacy [10];
- 3) effect of disorder cues is smaller than originally thought and that neighborhood and individual characteristics moderate cue effects [11].

However, the theory has received numerous criticisms for years [12], [13], especially about the following major issues:

- 1) Inadequate theoretical validity:

Technical papers submitted for publication must advance the state of knowledge and must cite relevant prior work.

- 2) Limits of practicality:

It is not clear as to which of the city's various problems are linked to crime. The practicality is limited because it is not evident what problems should be prioritized for crime prevention, and hence, it is difficult to identify effective measures.

In order to deal with these issues, it is necessary to prove the relationship between local problems and crime rate, not as a rule of thumb. It is necessary to be able to estimate what kind of problem countermeasures would be effective.

### B. Spread of the Use of Citizen Report Systems

In this study, as a means of observing local problems with quantitative data, we focused on the data collected through the citizen report system (hereinafter referred to as "citizen report data").

The pioneer of the citizen report system was FixMyStreet in the UK, which started its service in 2007. The system was originally developed to solve problems such as road damage, as its name suggests. However, the approach has attracted attention as an epoch-making attempt to redefine the relationship between citizens and the government from the beginning, and various studies have been conducted on the significance of the approach, social functions, and proposals for new uses [14]. Recently, a research that positions the discovery of problems by citizens as a kind of sensor and tries to explain its social significance was carried out [15]. In Japan, various explanations about the mechanism and social significance of "Chiba Repo" and "FixMyStreet Japan®" have been indicated mainly by organizations and related parties involved in the planning and operation of citizen report systems [16], [17].

### C. Changes in Data Usage Environment and Significance of this Research

The environment surrounding Japan's citizen report data has greatly changed due to the Basic Act on the Advancement of Public and Private Sector Data Utilization that was promulgated and enforced in December 2017. By showing the direction on how to actively use the data held by government agencies, it is now easier to obtain government-owned data that was previously difficult to access. The citizen report data used in this study were also provided by municipalities. Starting 2019, data related to crimes were also made publicly available from each prefectural police headquarters in a machine-readable and secondary-usable format (hereinafter referred to as "open data") [18].

In this study, by using these data, the local problems that were difficult to observe before were identified and their relationship with crime rate was analyzed. Furthermore, to determine whether the analysis result could be verified using the broken windows theory, the significance of the analysis of citizen report data in the prevention of local crimes was clarified.

## III. VERIFICATION METHOD OF THE RELATIONSHIP BETWEEN CITIZEN REPORTS AND CRIME RATE

In this chapter, verification method of the relationship between citizen report rate and the crime rate of thieves will be discussed.

### A. Citizen Report Data for Use

In this study, three ordinance-designated cities, Chiba City, Hamamatsu City, and Sagamihara City, in which the cumulative number of citizen report exceed 1,000 and the operation period are over four years, were analyzed.

These cities have one of the largest citizen report systems operated by Japanese municipalities. Table I shows the citizen report data provided by the three cities and the number of theft crimes in 2018 published as open data on the website of the prefectural police headquarters in charge of each city. These numbers were counted for each administrative district of the ordinance-designated city and used for analysis.

TABLE I: CITIZEN REPORT DATA USED IN THIS STUDY

City name	Number of records	Period
Chiba	4,574	2014.8-2018.3
Hamamatsu	1,344	2015.4-2019.5
Sagamihara	2,331	2015.1-2018.12

### B. The Hypothesis of the Relationship between Citizen Report and Crime Rate

This study examined the following two hypotheses:

First, if the broken windows theory holds, in the district where many problems were reported by citizen report, light crimes such as theft, should have more likely occurred. Therefore, there should be a positive correlation between citizen report rate and the crime rate of thieves.

Second, various kinds of problems are reported in the citizen report. According to Kano et al., problems in citizen report in Chiba City fall into the seven categories shown in

Fig. 1. This classification also works effectively for the other two cities [19]. This includes a variety of issues, from damages to public installations, where the relationship with crime can be easily guessed, to road damage, where the relationship with crime is difficult to imagine. Therefore, depending on the type of crime, there should be a difference between when the relationship with the problem reported is strong and when it is weak.

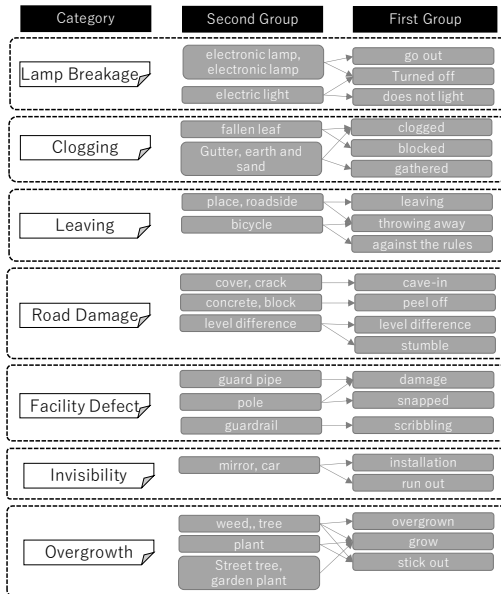


Fig. 1. Parts of variety of problems included in citizen reports.

#### IV. RELATIONSHIP BETWEEN CITIZEN REPORT RATE AND CRIME RATE OF THIEVES

In this chapter, the former hypothesis, whether the broken window theory is applicable to the relationship between city problems reported by citizen report and occurrence of crimes such as theft, presented in the previous chapter, will be examined.

##### A. Analysis Procedure

TABLE II: VARIABLES FOR CORRELATION ANALYSIS OF CITIZEN REPORT RATE AND CRIME RATE

Ordinance-designated city	Administrative districts	Citizen report rate *1	Crime rate *2
Chiba City	Chuo	71.04	97.90
	Hanamigawa	22.08	47.30
	Inage	34.03	64.60
	Wakaba	20.11	56.70
	Midori	70.33	42.10
Hamamatsu City	Mihama	66.91	62.00
	Naka	19.96	45.19
	Higashi	21.82	40.15
	Nishi	14.99	30.16
	Minami	14.06	34.40
	Kita	22.61	26.92
Sagamihara City	Hamakita	12.63	25.68
	Tenryu	16.34	30.49
	Midori	22.96	45.16
Sagamihara City	Chuo	33.79	49.53
	Minami	24.63	41.64

\*1 Number of citizen reports per 10,000 population

\*2 Number of theft crimes per 10,000 population

For each administrative district of the three

ordinance-designated cities analyzed in this study, the incidence rate per 10,000 population of citizen report (hereinafter referred to as “citizen report rate”) was summed up. Similarly, the incidence of theft per 10,000 people (hereinafter referred to as “crime rate”) was also summed up for each administrative district. Then, the correlation between citizen report rate and crime rate was analyzed for each administrative district. Table II shows the data of the citizen report rate and crime rate used for correlation analysis as the variables.

##### B. Result of the Analysis

The correlation coefficient between the citizen report rate and crime rate calculated from the data shown in Table III was 0.68, indicating a positive correlation (significant at 1% level). Fig. 2 shows the results of the simple linear regression analysis with crime rate as the objective variable and citizen report rate as the explanatory variable.

##### Summary

Regression statistics	
Multiple correlation R	0.684039
Multiple coefficient of determination R2	0.46791
Correction factor R2	0.429904
Standard error	13.64101
Number of observations	16

##### Analysis of variance table

	Degree of freedom	Fluctuation	Dispersion	Observed dispersion ratio	Significant F
Regression	1	2290.86	2290.86	12.31134	0.003474
Residual error	14	2605.082	186.0773		
Total	15	4895.942			

	Coefficient	Standard error	t	P-Value	Lower limit 95%	Upper limit 95%
Intercept	27.58737	6.317197	4.367028	0.000644	14.03833	41.13641
X Value 1	0.611395	0.174249	3.508751	0.003474	0.237669	0.985121

Fig. 2. Result of the single regression between citizen report rate and crime rate.

As a result of the above analysis, it was confirmed that there was a tendency that the more problems reported by citizen report, the more crimes occurred. Thus, it can be said that the validity of the broken windows theory has been verified by the analysis of citizen report data.

#### V. RELATIONSHIP WITH CRIME RATE FOR EACH PROBLEM CATEGORY

In this chapter, the latter hypothesis shown in Chapter 3, that is, whether the type of crime makes a difference between when the relationship with the problem reported is strong and when it is weak.

##### A. Analysis Procedure

Citizen report of the three cities analyzed in this study were classified into seven categories according to the classification shown in Table 2 and can be further clustered to narrow them down to four categories. As shown in Fig. 3, the seven categories were clustered by creating a dendrogram using the Ward’s method and grouping them into appropriate categories. As a result, they were classified into four categories as shown in [A] to [D] in Fig. 3.

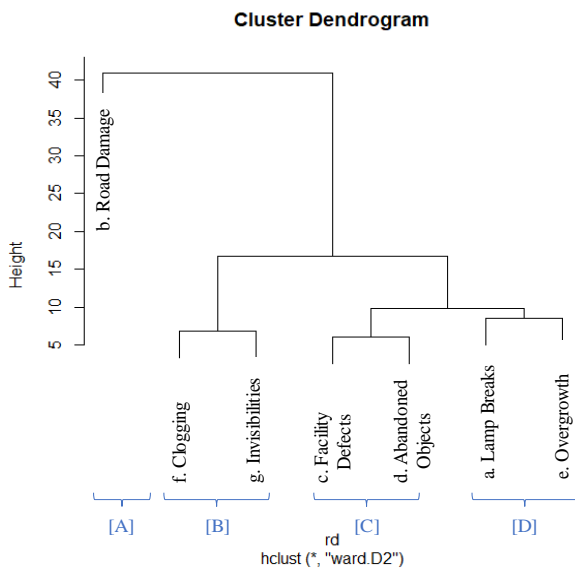


Fig. 3. Cluster dendrogram of problem categories.

**B. Result of Analysis**

Based on the above analysis, the categories [A] to [D] can be further classified into the following three groups according to the strength of the correlation as shown in Fig. 4:

Group (1) with strong positive correlations:

→ Category [C]

Group (2) with positive correlations:

→ Category [B] and [D]

Group (3) of uncorrelated groups:

→ Category [A]

The strength of the correlation between the problems belonging to these groups and the crime rate can be explained as follows:

- 1) Group (1) with strong positive correlation (correlation coefficient of 0.7 or more)  
Both the problems “Facility Defects” and “Abandoned Objects” within the same group were likely to occur mainly intentionally. It can be reasonably understood that where public property is often damaged, crime is likely to occur.
- 2) Group (2) with positive correlation (correlation coefficient 0.4 to 0.7)  
“Clogging,” “Invisibilities,” “Lamp Breaks,” and “Overgrowth” were all problems that were not usually caused by someone intentionally but as a result of deteriorating public facilities and lack of proper efforts to improve the condition. Although it is not as strong as in the case of (1), which is caused mainly intentionally, in case a problem was left unaddressed, it could have a certain effect on criminal psychology.
- 3) Group (3) Uncorrelated group (correlation coefficient 0.2 or less)  
“Road damage” was uncorrelated with crime rate. It can be said that road pavement damage cannot affect criminal psychology.

From the above, it is clear that the difference in the relationship between citizen report rate and crime rate can be explained consistently and reasonably.

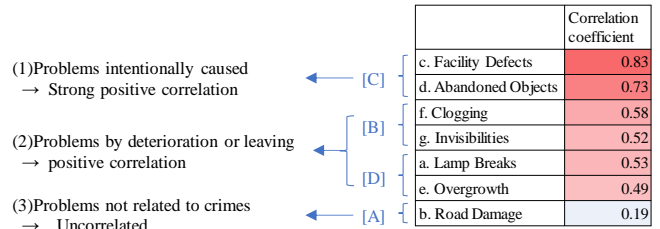


Fig. 4. Groups clustered by degrees of correlation.

**VI. CONCLUSION**

The purpose of this study was to clarify the significance of the analysis of citizen report data in the prevention of local crimes. Specifically, we tried to verify the validity of the broken windows theory by using data obtained from the citizen report system. Broken windows theory is a theory that appeared during the development of environmental criminology, and many people identified with it and had great expectations for a period of time. In addition, by analyzing the relationship with crime rate for each problem classification of citizen report, we found what kind of problem was effective in reducing the crime rate.

As a general trend, the following suggestions were obtained:

- 1) In areas where crime rate is high, there is a high possibility that the crime rate can be reduced by focusing on problems of “Facility Defects” and “Abandoned Objects” that are mainly caused intentionally.
- 2) Addressing issues that arise primarily due to the deterioration of public facilities and negligible efforts to improve it, such as “Clogging,” “Invisibilities,” “Lamp Breaks,” and “Overgrowth,” may also help in reducing crime rate.
- 3) Dealing with “Road Damage” does not contribute to reducing crime rate.

This result suggests that the broken windows theory is actually valid and is likely to be useful for solving actual problems.

On the other hand, the area studied in this research was limited to large-scale municipalities with a certain tendency as ordinance-designated cities. In the future, in order to verify the general validity of the broken windows theory using the framework of this study and linking it to concrete crime prevention measures, it is necessary that the same analysis is conducted for municipalities other than these three cities and on the kind of relationship found between citizen report rate and crime rate.

The environment of available data is also changing. Citizen report systems have already been introduced in many municipalities, and data are being accumulated daily. The number of municipalities introducing this system is increasing every year. In addition, the trend of government holding data to open data is thought to be a tailwind for such research. It seems that more diverse data will be available in the future.

As the diversity and amount of available data expands in this way, more diversified research becomes possible, and the suggestions obtained from it are expected to become wider.

### CONFLICT OF INTEREST

The authors declare no conflict of interest.

### AUTHOR CONTRIBUTIONS

Tsuda provided guidance and supervision for the entire research; Kano conducted the research, analyzed the data and wrote the paper; all authors had approved the final version.

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