CRIME PREVENTION AND COMMERCIAL BURGLARY: A TIME SERIES ANALYSIS

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ABSTRACT

The impact of crime prevention on commercial burglary in a section of Portland, Oregon is assessed. Using time series analysis, and a control area for comparison, some of the problems of previous crime prevention research are addressed. The results of the study discussed show that not only was there a significant reduction in commercial burglary, but the effect persisted. Several rival hypotheses which could explain this reduction are rejected and suggestions for future research are offered.

Street lights can be like that famous stone that falls in the desert where there are no ears to hear. Does it make a noise? Without effective eyes to see, does a light cast light? Not for practical purposes.

Jane Jacobs, 1961

The influence of the physical environment on crime has drawn increasing attention in recent years. The pioneering work of Jacobs (1961) represents an early attempt to explain how contingencies in the physical environment can influence the crime rate in an area. More recently, Angel (1968) and Newman (1972), among others, have examined how various physical elements of the environment can affect the level of crime. Generally, these studies suggest that certain physical changes may reduce the opportunity for committing crimes, and several techniques have since been devised to re-duce crimes through environmental design. The study described here is part of a larger replication of a crime prevention through environmental design (CPTED) project which was undertaken in Portland, Oregon from 1975-1977 (Kaplan et al., 1978). In the original study, it was hypothesized that opportunities to commit crimes were related to the target, and to risk, effort, and payoff. To the degree that there are few easy crime targets in an area, that the risk of detection is high for criminals, that the effort needed to commit crimes is high, and that the payoff for committing a crime is low, it was predicted that the level of crime could be reduced. Several crime prevention techniques were implemented in the original study to reduce crime. For our purposes here, the installation of street lighting and commercial security surveys are of primary importance.

Unfortunately, although there have been numerous attempts to evaluate the efficacy of a variety of crime prevention measures, many of these studies suffer from serious methodological flaws. This point is emphasized in a recent critique of street lighting studies (Tien et al., 1979). The use of inappropriate statistical techniques and the lack of control areas are two problems which have often plagued earlier research.

The present study represents an effort to redress some of the methodological problems of previous studies through the use of a control area, as well as of interrupted time series analysis.

THE SETTING

In the mid-1970's, the Union Avenue Corridor (UAC) in Portland, Oregon, was chosen as a demonstration site to test CTPED theory in a commercial area. The corridor is three and a half miles long and four blocks wide and is a mixed-use commercial strip. Union Avenue runs north and south and is located in northeastern Portland; prior to the late 1950's, when the interstate freeway was completed, Union Avenue was the major interstate highway in Portland. There are a variety of businesses along the UAC, including car dealerships, grocery and variety stores, fast food and other restaurants, taverns, gas stations, drug stores, banks, light industry, and other small businesses. The residential area surrounding the UAC is comprised of low and moderate income individuals, and is racially mixed. About half of Portland's black population lives in the north and northeast areas surrounding the UAC.

In addition to the rerouting of traffic caused by the interstate, which was built in the late 1950's, a large mall (Lloyd Center) was constructed near the south end of the UAC in the early 1960's. This led to further economic decline in the area. Racial strife and disturbances in the 1960's also contributed to the deterioration of the UAC. By 1974, crime rates for robbery, burglary, assault, and purse snatching were about

three times the rate for the greater city. The area was selected as a demonstration site not only because of its high crime rate, but because city officials in Portland expressed an interest in CPTED.

METHODOLOGY

The original study, as well as the replication (of which this article is a part), considered a number of issues, but the scope of the study under review here is limited to the consideration of the impact of two crime prevention measures (street lighting and security surveys) on commercial burglary.[1] Before continuing, two caveats concerning this study should be mentioned. First, since the security surveys and street lighting installation took place during the same time period, it was not possible to assess the independent effects of the two measures. Secondly, due to time and budgetary constraints, no separate data were obtained for nighttime commercial burglary, even though it was assumed (especially in the case of street lighting) that the two crime prevention measures would have the greatest impact on nighttime commercial burglary. There is considerable evidence that a large majority of non-residential burglaries occur at night (Flanagan, Hindelang, and Gottfredson, 1980; Scarr, 1973). With the exception of the businesses that are closed on weekends, most of the businesses in the UAC have daytime hours, obviously precluding the possibility of burglary.

The rationale for using these two crime prevention measures follows the CPTED theoretical model outlined earlier. Street lighting would presumably increase the visibility of commercial burglars, thus increasing their risk of apprehension. The commercial security surveys were designed to encourage businessmen to employ various crime prevention measures that would make their establishments less vulnerable to burglary. Thus, not only could the number of businesses that are particularly susceptible to burglaries be reduced, but the effort required to burglarize more secure businesses,

and the risk of detection (because of both the increased time which might be necessary to complete a burglary and the installation of alarms), would be expected to increase. In general, then, it was predicted that the implementation of these two measures would deter potential burglars and reduce the incidence of commercial burglary. In addition to assessing the impact of street lighting and security surveys on commercial burglary, the replication was also designed to determine whether these measures had a persistent impact on commercial burglary or whether burglary returned to pre-intervention levels. These, then, are the two central questions addressed by our research.

IMPLEMENTATION

An issue which is often ignored in the evaluation of programs is the extent to which the programs are implemented. In the initial evaluation (Kaplan, et al., 1978), 210 commercial security surveys were conducted in February, 1976, and follow-ups were conducted in September, 1976 and February, 1977. The first follow-up indicated that 33% of the businesses had complied with initial recommendations; 52% had complied with recommendations after the second follow-up. The recommendations included: turning on inside and outside lights at night, installing burglar and silent alarms, and displaying crime prevention stickers. Businessmen were surveyed again in 1979; they generally adopted the same crime prevention measures as they had in 1977, with two exceptions. In 1979, only 74% indicated that they left inside lights on at night, and 33% noted that they displayed crime prevention stickers, while the respective proportions were 84% and 43% in 1977. In general, the findings suggest that similar proportions of businessmen employed similar crime prevention measures in 1977 and 1979.

The installation of street lighting began in January, 1976 and was completed in February, 1977, but it is unknown whether there was a systematic pattern to the installation of the lighting. High intensity, 250 watt, high pressure sodium lights were installed the length of the entire UAC (these are the same lights that the city of Portland installs on major arterials). In addition, 175 watt mercury vapor lights were installed along residential side streets. The present study used a visual survey of the area that indicated that the current level of street lighting was identical to the 1977 level, and that street lights had been well maintained.

SOURCES OF DATA

Monthly commercial burglaries reported to the police were obtained for the UAC and the remainder of the city of Portland from January, 1975 to December, 1979. Monthly UAC commercial burglaries were collected from Portland Police Bureau "run sheets" for the five year period. Run sheets include all crimes reported to the police as well as the *UCR* classification and place of offense. The *UCR's* for monthly commercial burglaries for the same time period were also collected for the whole city of Portland. The number of monthly commercial burglaries reported in the UAC were then subtracted from the monthly city-wide totals to provide a comparison group. (It should be noted that comparable data from the original evaluation were unavailable, preventing a direct comparison with the original findings.) Initially, an attempt was made to find a comparable area in Portland, but this was not possible given the large proportion of blacks residing along the UAC.

Another problem was that no data were available on the rate of street lighting installation. Still, it was assumed that the lights were installed at a gradual constant rate, rather than that there could be no effect from the street lighting until installation was completed.

FINDINGS

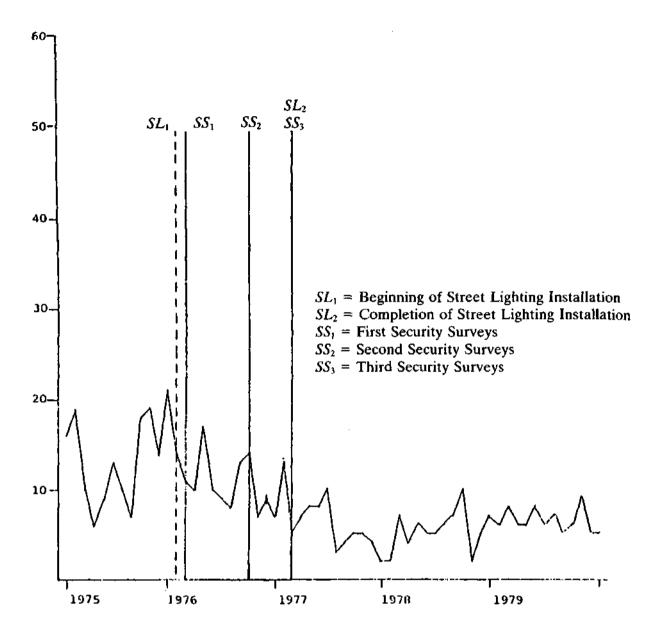A common problem encountered in analyzing monthly data is serial correlation

Figure 1. Monthly Commercial Burglaries in the Union Avenue Corridor

(correlation of the residuals), a factor which limits the use of ordinary least squares regression. Although there is some disagreement over whether this leads to biased parameter estimates, or to unreliable tests of significance, there is consensus that techniques other than ordinary least squares regression should be employed when there is serial correlation (McLeary and Hay, 1979; Ostrom, 1978; Rao and Miller, 1971). One method for dealing with autocorrelation of the residuals is various ARIMA (autoregressive integrated moving average)

models first developed by Box and Jenkins (1976).

Three separate analyses were undertaken to test for intervention effects on commercial burglaries. (See figures 1 to 3 for scattergrams for the UAC, the remainder of Portland, and the porportions of UAC to the remainder of the city.) Visual inspection suggests that the interventions may have affected commercial burglaries for the UAC (figure 1) and the proportion of UAC to commercial burglary in the remainder of Portland (figure 3), but not commercial
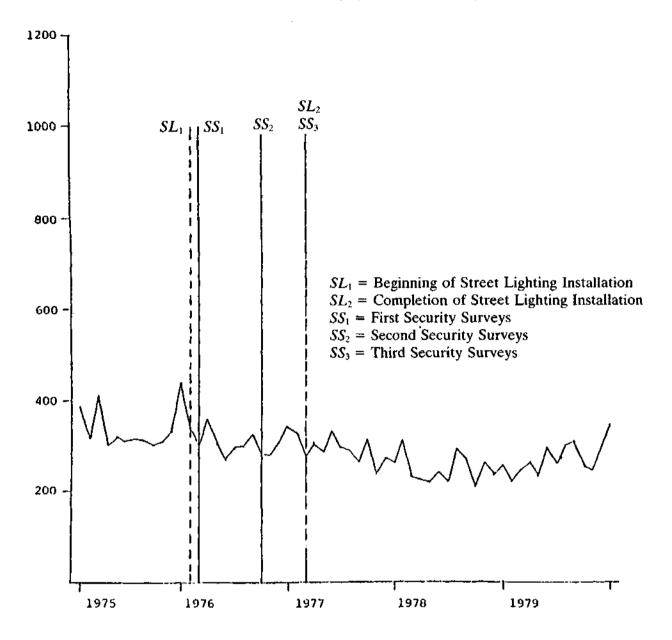
Figure 2. Monthly Commercial Burglaries in Portland

burglaries for the rest of the city (figure 2). However, the use of ARIMA models, adopting the procedure outlined by McLeary and Hay (1979), can provide a more definitive answer concerning the impact of the interventions. As noted earlier, a gradual intervention effect was hypothesized. This decision is based on the fact that even though the installation of street lighting began in January, 1976, it was not completed until February, 1977. Furthermore, even an abrupt intervention effect, following the security surveys, would not diminish the effect of the gradual installation of street lighting, which occurred simultaneously. Since no data on the actual rate of installation were available, a linear intervention was assumed (a dummy variable was coded 0 for the pre-intervention months, .076 for the first intervention month, ... 1 for the month that installation was completed and for the remaining months). This model assumes that the intervention effects remained constant in the post-intervention period.

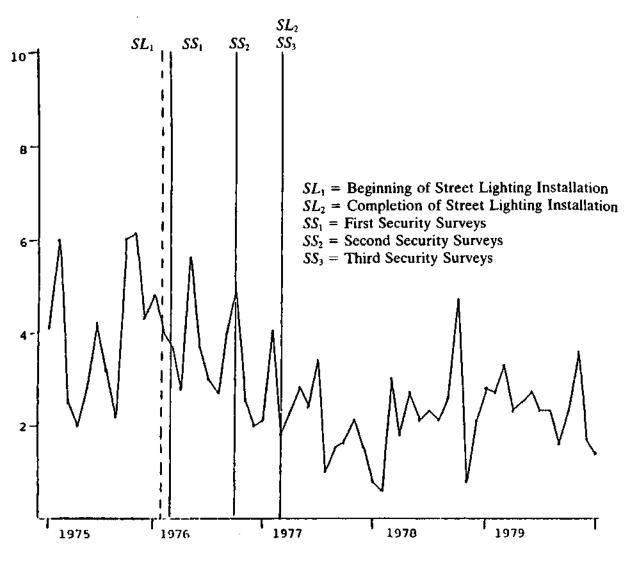In examining the three time series, an

Figure 3. Monthly Percentage for Proportion of Union Avenue Corridor Commercial Burglaries to Portland Commercial Burglaries

attempt was made to identify the most parsimonious models. The results are presented in Table 1. Although there was a significant decline in commercial burglaries $(t = -3.35, p < .01)$ in the UAC,[2] a corresponding decline was not found in the remainder of the city $(t = -.7, n.s.)$.[3] Nonetheless, to more directly test the proposition that street lighting and security surveys would reduce commercial burglaries, the proportion of UAC to Portland commercial burglaries was examined. Like the UAC finding, a marked reduction was observed $(/ = -2.23, p < .05)$. The average monthly proportion for the pre-intervention months was 3.9%, as compared to 2.5% for the remaining months. To reiterate, examination of proportions is probably the most conclusive test, because the remainder of the city serves as a control, ruling out the possibility that some event or events occuring throughout the city during or after the two crime prevention measures were implemented led to the observed reduction in commercial burglaries. In addition, rhos (r_s) were computed for the UAC as well as for the proportion of the UAC to the remainder of the city. Both were negative and significant $(r_s = -.59, p < .01; r_s = .41, p < .01)$. These findings support those of the earlier time series analysis.

There are several rival hypotheses which

TABLE 1

RESULTS OF TIME SERIES ANALYSIS FOR COMMERCIAL BURGLARIES

	Model	Constant (T-values)	b Intervention (T-values)	MAI (T-values)	AR2 (T-values)
UAC Commercial Burglary	ARIMA (0,1,1)	-0.03 (0.41)	-7.73 (3.35)***	0.94 (18.14)***	
Portland Commercial Burglary	ARIMA (0,1,1)	-0.55 (0.29)	-41.17 (0-71)	.69 (6.60)***	
Proportion of UAC to Portland Commercial Burglary	ARIMA (24,1)	0.43 (0.88)	-26.12 (2.23)**	0.73 (7.15)**'*	-0.30 (2.33)***

b = Regression Coefficient
MAX = Moving Average Order 1
AR2 = Autoregressive Order 2
** = Significant .05 level
*** = Significant .01 level

could account for the reduction in commercial burglaries in the UAC. Most obviously, since the UAC has been described as a deteriorating area, a reduction in the number of businesses in the area could reduce the opportunity for committing commercial burglaries. However, there were no dramatic changes in the number of ongoing businesses from 1975 to 1979. The greatest change occurred from 1975 to 1977, when there was an 8% decline in the number of businesses; but by 1979 the reduction in the number of businesses since 1975 was only 2%. Another hypothesis is that because the UAC is a depressed area, business sales may have declined, making businesses in the area less desirable burglary targets. However, most businessmen reported gains in sales from 1970 to 1979, with the greatest increase from 1975 to 1977. Furthermore, land values for the UAC were only slightly lower than they were for other commercial areas in Portland.

An additional alternative is that there was a dramatic population decline during the period of the study, reducing the number of potential burglars in the area. A comparison of census data for 1970 and 1980 indicates that the population in the area has remained virtually unchanged (in fact, it has increased slightly).[4] Although these are not the only rival hypotheses which could explain the observed intervention effects, they are some of the most obvious explanations for which evidence is available.

CONCLUSIONS AND IMPLICATIONS

The findings tend to support the proposition that the combined effects of commercial security surveys and street lighting led to a significant reduction in commercial burglaries in the UAC, and that this effect has been maintained since the demonstration project was completed in the UAC in 1977. There is ample evidence that these two crime prevention techniques have been institutionalized since the time the original study was undertaken. Not only have businessmen continued to employ a number of crime prevention techniques in the UAC,

but street lights in the area have also been well maintained.

The research described here attempts to avoid a number of pitfalls of previous crime prevention studies. In addition to examining monthly commercial burglaries with ARIMA models, the city of Portland is used as a control, and several rival hypotheses have been assessed and rejected. However, even though evidence indicates that neither a population decline (a measure of potential commercial burglars), nor a reduction in the number of operating businesses (a measure of potential commercial burglary targets) can account for the observed reduction in commercial burglaries in the UAC, it is plausible that some unique event or series of events occurred only in the UAC and not in the remainder of the city. This research does not preclude such a possibility, but failed to discover any occurrence(s) of this nature.

The design of the study does have at least one serious limitation, however. It is not possible to assess the relative influences of the security surveys and street lighting. All that can be concluded is that the combined effect of these two interventions apparently resulted in a reduction in commercial burglaries. A more complex design is necessary to evaluate the relative effects of these two crime prevention techniques—for example, a comparison of four areas: one where street lighting has been implemented, one where security surveys have been undertaken, one where both crime prevention techniques have been employed, and a control area. Such a design could provide a more direct measure of the relative efficacy of these two interventions. Most importantly, one of the reasons why street lighting studies may find no consistent impact on crime is that street lighting alone may be insufficient to deter potential criminals (Tien et al., 1979). Instead, street lighting may have an impact only when it is employed in conjunction with other crime prevention techniques. The development of more sophisticated research designs in the future could begin to address these issues.

NOTES

[1] In the original study as well as in the replication, the impact of the security surveys and/or street lighting on street crimes (assaults, purse snatching, street robbery, and rape), residential burglaries, and commercial robberies was also examined. These findings have not been reported here because no significant intervention effect was observed for any of these crimes. However, one of the reasons for examining commercial robberies and residential burglaries in the initial evaluation was to determine if reductions in commercial burglaries had the effect of displacing these crimes, resulting in an increase in residential burglaries and commercial robberies. In the present study, no displacement was observed.

[2] Although the original study also found a significant reduction in commercial burglary (Kaplan et al., 1978; Lavrakas, Normoyle, and Wagener, 1978), the findings are not directly comparable. Not only do the time periods for the two studies differ because an additional fifteen months of post-intervention data were examined in this study, but the sources of data are different, and no comparison area was included in the original evaluation. One of the reasons for conducting the replication was to determine whether the initial effects persisted, given the limited number of post-intervention months which were examined in the first study.

[3] Both the raw data and autocorrelations and partial autocorrelations are available from the author upon request.

[4] Likewise, it is plausible that less involvement in commercial burglary by blacks could explain the decrease in commercial burglaries. Admittedly, arrests offer only a very crude basis for determining involvement in crime. However, according to the *UCR*, from 1975 to 1979 the proportion of blacks arrested nationally has remained virtually constant at 29%.

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