

Effects of Improved Street Lighting on Crime

Protocol for a Systematic Review

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COVER SHEET

Title

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BACKGROUND FOR THE REVIEW

Contemporary interest in the effect of improved street lighting on crime began in North America during the dramatic rise in crime that took place in the 1960s. Many towns and cities embarked on major street lighting programs as a means of reducing crime, and initial results were encouraging (Wright et al., 1974).

The proliferation of projects across North America led to a detailed review of the effects of street lighting on crime by Tien et al. (1979) as part of the National Evaluation Program of the Law Enforcement Assistance Agency (LEAA). Their report described how the 103 street lighting projects originally identified were eventually reduced to a final sample of only 15 that were considered by the review team to contain sufficiently rigorous evaluative information.

With regard to the impact of street lighting on crime, Tien et al. (1979) found that the results were mixed and generally inconclusive. This was interpreted as showing that street lighting had no effect on crime and effectively ended research on the topic in the United States.

In the United Kingdom, little research on street lighting and crime was conducted until the late 1980s (Fleming and Burrows, 1986). There was a resurgence of interest between 1988 and 1990, when three small-scale street lighting projects were implemented and evaluated in different areas of London (Painter, 1994). In each location, crime, disorder, and fear of crime declined and pedestrian street use increased dramatically after the lighting improvements.

In contrast to these generally positive results, a major British Home Office-funded evaluation in Wandsworth (Atkins et al., 1991) concluded that improved street lighting had no effect on crime, and a Home Office review published simultaneously, also asserted that “better lighting by itself has very little effect on crime” (Ramsay and Newton, 1991, p. 24). However, as further evidence accumulated, there were more signs that improved street lighting could have an effect in reducing crime. In the most recent review, Pease (1999, p. 68) considered that “the capacity of street lighting to influence crime has now been satisfactorily settled.”

Explanations of the way improvements in street lighting could prevent crime can be found in “situational” approaches that focus on reducing opportunity and increasing perceived risks through modification of the physical environment (Clarke, 1995), such as Crime Prevention Through Environmental Design (Jeffery, 1977), and in perspectives that stress the importance of strengthening informal social control and community cohesion through more effective use of streets (Jacobs, 1961) and investment in neighborhood conditions (Taub et al., 1984; Taylor and Gottfredson, 1986).

It is also feasible that improved street lighting could, in certain circumstances, increase opportunities for crime. It may bring a greater number of potential victims and potential offenders into the same physical space. Increased visibility of potential victims may allow better judgements of their vulnerability and attractiveness (e.g., in terms of valuables). Greater social activity outside the home may increase the number of unoccupied homes available for burglary.

Higher illumination may make it easier to commit crimes and to escape.

OBJECTIVES OF THE REVIEW

The main objective of this review is to assess the available research evidence on the effects of improved street lighting on crime in public space. In addition to assessing the overall impact of improved street lighting on crime, this review will also investigate against which crimes and under what conditions it is most effective.

METHODOLOGY

Criteria for Inclusion and Exclusion of Studies in the Review

In selecting studies for inclusion in the review, the following criteria will be used:

1. Improved street lighting is the focus of the intervention. For studies involving one or more other interventions, only those studies in which improved street lighting was the main intervention will be included. The determination of the main intervention will be based on the study author identifying it as such or, if the author does not do this, the importance of improved street lighting relative to the other interventions.
2. There is an outcome measure of crime. Where applicable, crime outcome data will be reported separately for two main categories: official records (police reports) and unofficial measures (victim survey or self-report survey).
3. The evaluation design is of adequate or good methodological quality, with the minimum design involving before-and-after measures of crime in experimental and control areas. The unit of interest is areas.
4. There is at least one experimental area and one reasonably comparable control area.
5. The total number of crimes in each area before the intervention is at least 20. The main measure of effect size (see below) is based on changes in numbers of crimes between the before and after time periods. A minimum of 20 crimes in the before period was set because it was considered that a measure of change based on an N below 20 was potentially misleading. Also, any study with less than 20 crimes before would have insufficient statistical power to detect changes in crime. (The criterion of 20 is probably too low, but we are reluctant to exclude studies unless their numbers are clearly inadequate.)

Studies that do not meet one or more of the above criteria will be excluded from the review. Both reviewers will independently screen the full text of studies and recommend whether to include them in the review. Disagreements will be resolved upon discussion and if no resolution is achieved, the study will not be included in the review. Each excluded study will be listed along with a reason for its exclusion.

Search Strategy for Identification of Relevant Studies

The following four search strategies will be carried out to identify studies meeting the criteria for inclusion in the review:

1. Searches of on-line data bases (see below).
2. Searches of literature reviews on the effectiveness of improved street lighting in preventing crime.
3. Searches of bibliographies of street lighting studies.
4. Contacts with leading researchers.

Both published and unpublished studies will be considered. Searches will be international in scope and will not be limited to the English language.

The following data bases will be searched:

1. Criminal Justice Abstracts.
2. National Criminal Justice Reference Service (NCJRS) Abstracts.
3. Sociological Abstracts.
4. Social Science Abstracts (SocialSciAbs).
5. Educational Resources Information Clearinghouse (ERIC).
6. Government Publications Office Monthly Catalog (GPO Monthly).
7. Psychology Information (PsychInfo).
8. Public Affairs Information Service (PAIS) International.
9. Dissertation Abstracts.
10. Australian Criminology Database (CINCH).

The following terms will be used to search the databases:

1. Street lighting.
2. Lighting.
3. Illumination.
4. Natural surveillance.

Where applicable, “crime” will be added to each of the above terms (e.g., street lighting and crime) to narrow the search parameters.

Description of Methods Used in Primary Research

The following descriptions are of two of the street lighting studies, one in the United States and one in the United Kingdom, that have been judged to meet the inclusion criteria for the review.

An improved street lighting scheme (a fourfold increase in illumination quality) was implemented in the city center of Atlanta in the early 1970s to address a problem with robberies (Atlanta Regional Commission, 1974). An evaluation of the scheme 12 months after the improved lighting was implemented showed that robberies and burglaries decreased in the experimental area, whereas the incidence of these crimes increased in the control area. There was an increase in assaults in the experimental area, but the number was relatively small (from 11 to 57). Overall, daytime crime decreased by 16.4% in the experimental area after the

improved lighting, in comparison with an increase of 33.3% in the control area. Nighttime crime increased considerably in both areas.

Shaftoe (1994) evaluated an improved street lighting scheme (a twofold increase in illumination quality) implemented in residential neighborhoods in two police beats in Bristol, England, in the late 1980s and early 1990s. Street lighting was gradually improved in different places in the neighborhoods over a period of 28 months. Information about crime was provided for nine successive six-month periods overlapping this period. Therefore, the first 12-month period before the improved lighting (January to December 1986) was compared with the last 12-month period after the improved lighting (July 1989 to June 1990). This comparison showed that total, nighttime, and daytime crimes decreased in the experimental area after the intervention and increased in the control area.

Criteria for Determination of Independent Findings

In the case of studies that measure the impact of improved street lighting programs on crime and other outcomes (e.g., fear of crime, commercial activity in city centers), only crime outcomes will be examined as part of the review.

In the case of studies that measure the impact of improved street lighting programs on crime at multiple points in time, similar time periods (e.g., 12 months) will be compared (as far as possible).

Where time series data are available we will attempt to analyze them.

Details of Study Coding Categories

The following characteristics of the included studies (where available) will be retrieved and retained for examination as potential moderators of study outcomes:

1. Author, publication date, and location. The authors and dates of the most relevant evaluation reports and the location of the program will be identified.
2. Context of intervention. This is defined as the physical setting in which the street lighting intervention took place.
3. Lighting improvement. The increase in the intensity of illumination of the street lighting will be identified.
4. Coverage. The coverage area of street lighting will be identified.
5. Duration of intervention. The length of time the program was in operation will be identified.
6. Sample size. The number and any special features of the experimental and control areas will be identified.
7. Other interventions. Interventions other than improved street lighting that were employed at the time of the program will be identified.
8. Outcome measure of interest and data source. Crime is the outcome measure of interest to the review. The specific crime types and the data source of the outcome

measure (e.g., police records, victim survey) will be identified.

9. Time of day. Some theories predict that improved street lighting will lead to a reduction in both daytime and nighttime crime. The time of day that crime is measured will be identified.

10. Research design. The type of evaluation design used to assess the program's impact on crime will be identified. If matching or other statistical analysis techniques are used as part of the evaluation of program effects, these will be noted.

11. Before-after time period. The before and after time periods of the evaluation will be identified.

As noted above, the outcome measure of interest to this review is crime, specifically, property (e.g., burglary, theft of vehicles) and violent (e.g., assault, robbery) crimes. In summarizing results, the focus will be on the outcome of interest to this review and comparisons between experimental and control areas (see below for more details).

The review will also report on studies of displacement of crime and diffusion of crime prevention benefits. Displacement is often defined as the unintended increase in crimes in other locations following from the introduction of a crime reduction scheme. Six different forms of displacement have been identified: temporal (change in time), tactical (change in method), target (change in victim), territorial (change in place), functional (change in type of crime), and perpetrator (Reppetto, 1976; Barr and Pease, 1990). Diffusion of benefits is often defined as the unintended decrease in crimes in other locations following from a crime reduction scheme, or the "complete reverse" of displacement (Clarke and Weisburd, 1994). In order to investigate territorial displacement and diffusion of benefits, the minimum design involves one experimental area, one adjacent area, and one non-adjacent control area. If crime decreased in the experimental area, increased in the adjacent area, and stayed constant in the control area, this might be evidence of displacement. If crime decreased in the experimental and adjacent areas and stayed constant or increased in the control area, this might be evidence of diffusion of benefits.

Where information is provided about the number of targets in an area (e.g., number of pedestrians, number of houses or cars), we will analyze it to study crime rates. One methodological problem is that improved street lighting may cause more people to use the streets and hence cause more targets and opportunities for crime.

Coding reliability will be established by the use of a descriptive checklist of all moderating variables of interest to the review. Coding reliability will be monitored by the co-reviewer who will review a random sample of studies.

Statistical Procedures and Conventions

We plan to carry out a meta-analysis in order to estimate the average effect size in evaluations of the effects of improved lighting on crime. In order to complete a meta-analysis, a comparable

effect size is needed in each evaluation, together with its variance. This has to be based on the number of crimes in experimental and control areas in time periods (most commonly of 12 months) before and after the intervention, because this is the only information that is regularly provided in all the evaluations.

While studies based on police records can present time series data, studies based on victim surveys usually have data only for one time period before the intervention and one time period after. Because of the problem that the intervention may cause more reporting to police and recording by police, it is important to analyze both police and victim survey data.

We will use the odds ratio (OR) to measure the effect size. The OR is calculated from the following table:

| | | |
|--------------|--------|-------|
| | Before | After |
| Experimental | a | b |
| Control | c | d |

where a, b, c, d are numbers of crimes
OR = ad/bc

In calculating an average effect size for all or a subset of the studies, it will be inversely weighted according to the variance of each study, as specified in Lipsey and Wilson (2001). Also, in calculating an average effect size for all or a subset of the studies, statistical tests will be carried out to assess if the individual effect sizes were randomly distributed around the average effect size (or if there is heterogeneity). Moderators that predict effect sizes will be investigated (where available).

The OR is meaningful because it specifies the relative change in crime in a control area compared with an experimental area. The main conclusion of our previous meta-analysis of 13 evaluations (Farrington and Welsh, 2002) was that the weighted average OR = 1.25, with a confidence interval of 1.18 – 1.32. This shows that crime increased 25% more in control areas than in experimental areas, or conversely that crime decreased 20% more in experimental areas than in control areas (using the inverse of the OR = 1/1.25).

The difference between experimental and control areas was statistically significant because the confidence interval of the OR did not include 1.0. Hence, we concluded that, taken together, these 13 evaluations suggested that improved lighting caused a decrease in crime.

The variance of OR is calculated from the variance of LOR (the natural logarithm of OR). The usual calculation of this is as follows:

$$V(\text{LOR}) = 1/a + 1/b + 1/c + 1/d$$

We have received statistical advice from Dr. Patricia Altham of the Centre for Mathematical

Sciences, University of Cambridge, that this estimate of the variance needs to be corrected in two ways:

1. It needs to be decreased to take account of positive dependence (the correlation r) between the number of before crimes and the number of after crimes experienced by victims.
2. It needs to be increased to take account of overdispersion ϕ (the ratio of the variance to the mean of the number of crimes experienced by victims).

$$V^1(\text{LOR}) = \phi(V - C)$$

Where $V^1(\text{LOR})$ = corrected variance of LOR

$$\text{and } C = 2r[1/\sqrt{ab} + 1/\sqrt{cd}]$$

The values of r and ϕ are not fully known for these evaluations. However, based on the best estimates of these values in the Dudley study ($r = .3 - .4$; $\phi = 3 - 5$), the corrected variance would be about 2-3 times greater than the original variance. We therefore recalculated our meta-analysis assuming that every $SE(\text{LOR})$ was (i) 50% greater, and (ii) 80% greater, to give some idea of the likely range of results. This is equivalent to a range of variances between 2.25 times and 3.24 times the original variances.

The results are summarized in Table 1, which shows meta-analysis results with a fixed effects model and with a random effects model. A random effects model should be used where there is significant heterogeneity in effect sizes. In the original analysis, there was significant heterogeneity ($Q = 56.91$, 12 df, $p < .0001$). Assuming that every $SE(\text{LOR})$ was 80% greater, the heterogeneity Q was no longer significant ($Q = 17.56$, 12 df, $p = .13$).

Table 1: Results of Meta-Analysis Assuming Different Variances of Effect Sizes

| Meta-Analysis | SD(LOR) | WMES | Confidence Interval |
|----------------|----------|------|---------------------|
| Fixed Effects | Original | 1.25 | 1.18 - 1.32 |
| Random Effects | Original | 1.28 | 1.11 - 1.48 |
| Fixed Effects | 1.5X | 1.25 | 1.15 - 1.35 |
| Random Effects | 1.5X | 1.26 | 1.09 - 1.46 |
| Fixed Effects | 1.8X | 1.25 | 1.13 - 1.38 |
| Random Effects | 1.8X | 1.25 | 1.09 - 1.44 |

Note: WMES = weighted mean effect size.

These analyses show that our previous conclusions were not substantially changed by increasing the variance of each effect size. The weighted mean effect size is still at least 1.25 and is still statistically significant, although the confidence intervals are wider. We will incorporate these new estimates of the variance of the OR in our systematic review.

Treatment of Qualitative Research

Qualitative research will not be included in this systematic review and meta-analysis.

TIME FRAME

| | |
|--|------------|
| Searches for Published and Unpublished Studies | Completed |
| Pilot Testing of Inclusion Criteria | Completed |
| Relevance Assessments | Completed |
| Pilot Testing of Study Codes and Data Collection | Completed |
| Extraction of Data from Research Reports | March 2004 |
| Statistical Analysis | May 2004 |
| Preparation of Report | July 2004 |

PLANS FOR UPDATING THE REVIEW

The review will be updated every two years. The two reviewers will be responsible for the next update and all updates thereafter.

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STATEMENT CONCERNING CONFLICT OF INTEREST

There is no conflict of interest.

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