

Crime Reduction: What Works? How do we know? Are we sure?

Evidence-Based Policies and Indicator Systems.
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Paul Marchant
Leeds Metropolitan University
p.marchant@leedsmet.ac.uk

(Others involved in developing some of this work are:
Paul Baxter and Stuart Barber, Department of Statistics,
The University of Leeds)

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Aim

- A look at knowing 'What Works'.
- The discipline of statistics is important in knowing 'what works' in crime reduction.
- We need to be clear that any change seen when a crime reduction intervention is in place really is different from what might have happened anyway; i.e. how does it compare with variation which occurs when nothing in particular is introduced.

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Key Themes

- The path to knowledge is by using appropriate data from observation and experiment, properly handled.
- Science: an inherently uncertain matter, so we need the discipline of statistics.
- Not all results given are the same. Therefore there is the need to synthesise research evidence.
- Science is a public matter: not just because of the impact of the products, but also because of the need to check work.
- Need protocols to be published in advance and kept available for future reference.
- Need open access to pretty much everything; so that the work can be replicated and checked (data, methods, clear complete reports).
- Need to make assumptions for inferring conclusion clear.

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Some quotations

"The combination of some data and an aching desire for an answer does not ensure that a reasonable answer can be extracted from a body of data." John Tukey

"While every data set contains noise, some data sets may contain signals. Therefore before you can detect a signal within any given data set you must first filter out the noise."

Donald J. Wheeler in Understanding Variation: the key to managing chaos. Pub SPC

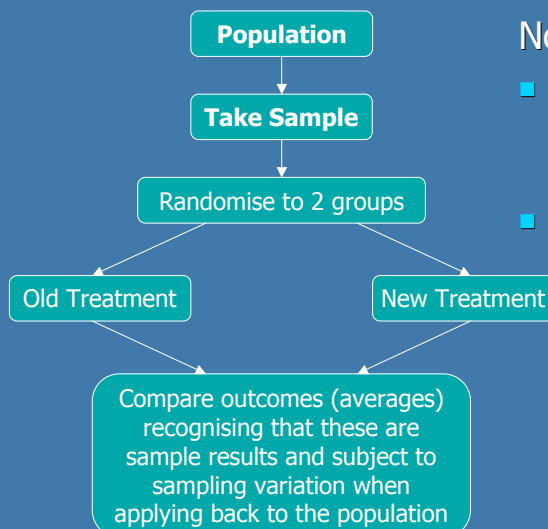
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Time Variation in Crime

- It appears that little is known about how crime varies on the small scale.
- Therefore it is difficult to be clear if any changes are due to a crime reduction intervention.
- Much more needs to be known about the occurrence of crime events to know how to analyse them properly to be able find effects.
- Need access to suitable data sets to examine this issue.
- (Need to guard against systematic error too.)

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The Randomised Controlled Trial (A truly marvellous scientific invention)



Note to avoid 'bias':

- Allocation is best made tamper-proof.
(e.g. use 'concealment')
- Use multiple blinding of:
 - patients,
 - physicians,
 - assessors,
 - analysts ...

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Counts of those cured and not cured under the two treatments

	Cured	Not Cured
New Treatment	a	b
Control (Standard treatment)	c	d

By comparing the ratios of numbers 'cured' to 'not cured' in the 2 arms of the trial, it is possible to tell if the new treatment is better.

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Confidence Intervals

- However there is *sampling variability*, because we don't study everybody of interest; just our *random sample*.
- So cannot have perfect knowledge of the effect of interest, but only an estimate of it within a confidence interval (CI).
- Need to know how to calculate the CI appropriately. This can be done under assumptions, which seem reasonable for the case of a clinical RCT and leads to a simple formula for the CI.

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Crime counts before and after in two areas one gets a CRI

	Before	After
Treatment Area (Intervention is introduced between the 2 periods)	a	b
Comparison Area (Nothing is changed)	c	d

A similar table results. But this is not the same as the RCT set up as:

- 1 Not randomised, so no statistical equivalence exists at the start.
- 2 The unit is area, rather than crime event.

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Lighting and crime

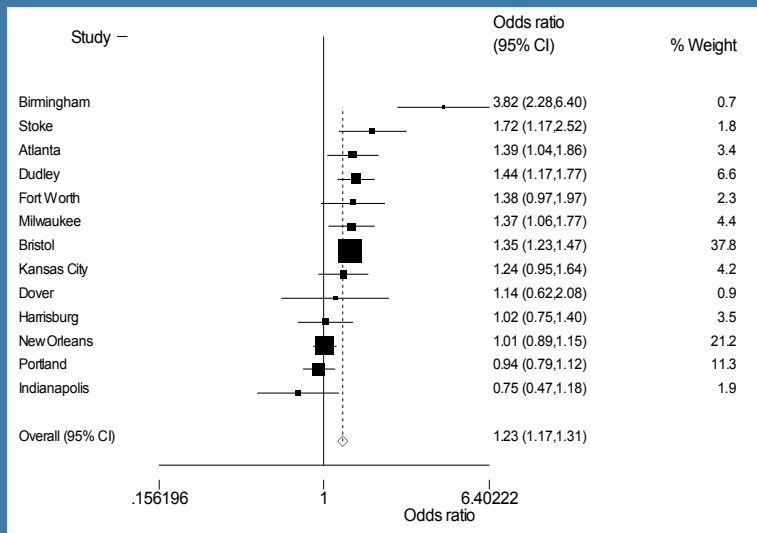
There seem to be many 'theoretical suggestions' why lighting might increase or decrease crime.

The meta-analysis, HORS251, by Farrington and Welsh suggests strongly that lighting beats crime. However my contention is that this study remains flawed and so we are ignorant of the effect of lighting on crime.

Much justification for exterior lighting is made on the basis of crime reduction, (e.g. the by lighting industry)

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Forest Plot as HORS 251 Meta-analysis reconstructed



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But this can't be right.

- The assumptions for calculating the CIs cannot be correct, in this case.
- Too much variation (heterogeneity) exists between individual study results compared with the uncertainty indicated by confidence intervals, (if the lighting has the same effect on crime in every study) (Heterogeneity).
- Note there is great variation in crime counts between periods in the comparison areas, where nothing is changed, so the heterogeneity is inherent to the natural variation of crime.

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Pointing out the problem

- I had a 7 page article, Marchant (2004), in the British Journal of Criminology drawing attention to the problem. The formula for the CIs used must be inappropriate (also mentioning other short-comings).
- The authors of HORS251 had 20-page response on the next page, justifying the claim that lighting reduces crime.
- But I remain unconvinced by the claim.

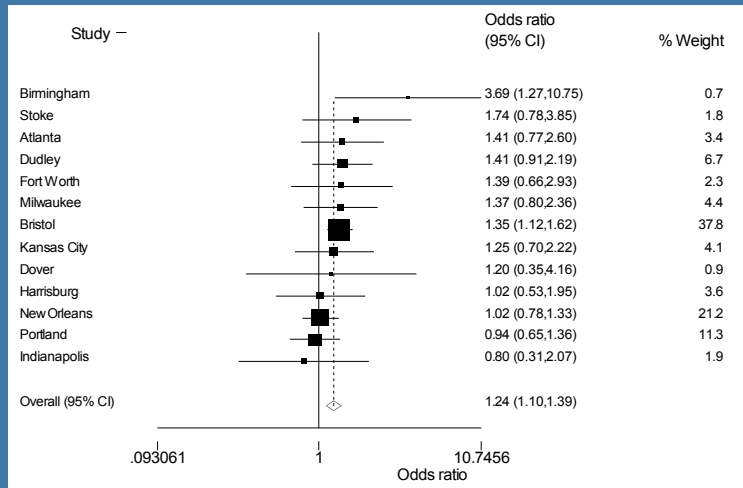
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Fixing the Heterogeneity Problem

- A way of making the problem go away is simply to increase the uncertainty, i.e. stretch the CIs . ('A quasi-Poisson model').
- Here the CIs are stretched by a factor of 2.1. (Equivalent to reducing the events counted in every setting by a factor $2.1^2 = 4.4$.). This adjustment has been made by the authors.
- Problem solved.... or is it? Is such model plausible?.

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Forest Plot reconstructed; Now with Overdispersion=4.4



Note: Only Birmingham and Bristol show statistically significant effect. (These 2 studies have more time points than just one before and one after giving more information and insight).

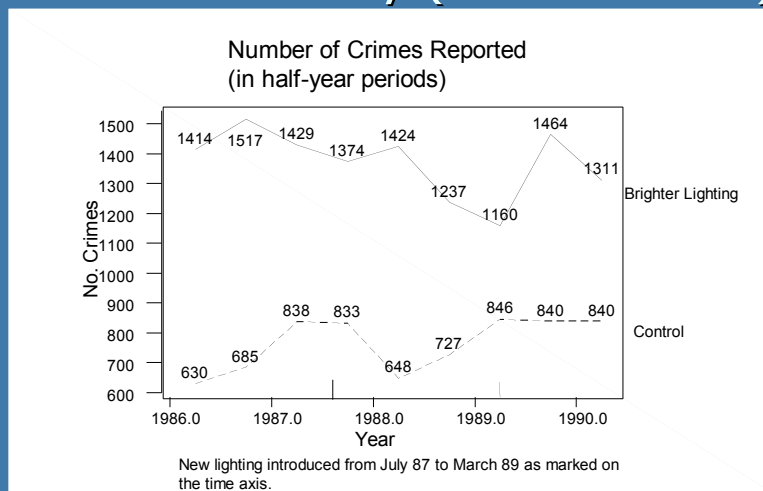
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What does this show?

- Original effect: 1.24; CI (1.17, 1.31)
- Revised effect: 1.24; CI (1.10, 1.39)
- Still claim a highly statistically significant overall effect.
- Always look at the data.
- Here look at the data from the 2 supposedly 'statistically significant' study results.

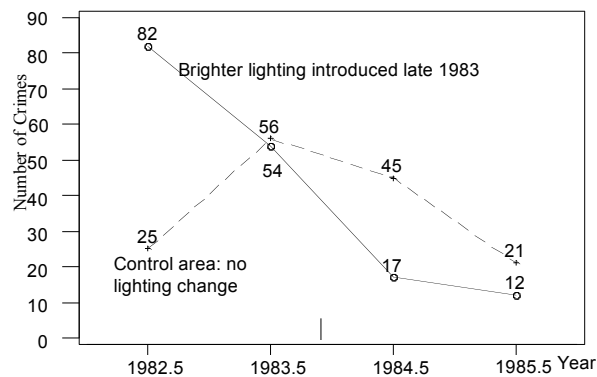
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The Bristol Study (Shaftoe 1994)



Shaftoe said 'no discernable lighting benefit' but HORS251 said $z=6.6$
 Note: had the data for the year immediately prior to the introduction of the relighting, i.e. periods 2 and 3, been used rather than unnaturally using periods 1 and 2 which leaves a gap of $\frac{1}{2}$ year, the effect found would have been half of that claimed. (Shows large variability.)¹⁷

Birmingham Indoor Markets Study (Poyner and Webb 1997)



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What to conclude from the 2 'statistically significant' studies

- Hardly convincing evidence for claimed effect, bearing in mind the changes in crime when lighting is not changed.
- Post hoc, ad hoc justification is always a possible refuge in the absence of scientific evidence. But that is not science.
- Crime varies markedly due to a variety of uncontrolled causes.
- Unconvinced of the claimed effect.
- Lighting *may* be good at reducing crime but we need to see good scientific evidence to accept the claim.
- More information is needed from good quality studies.
- (Note a number of the original study reports are grey literature.)

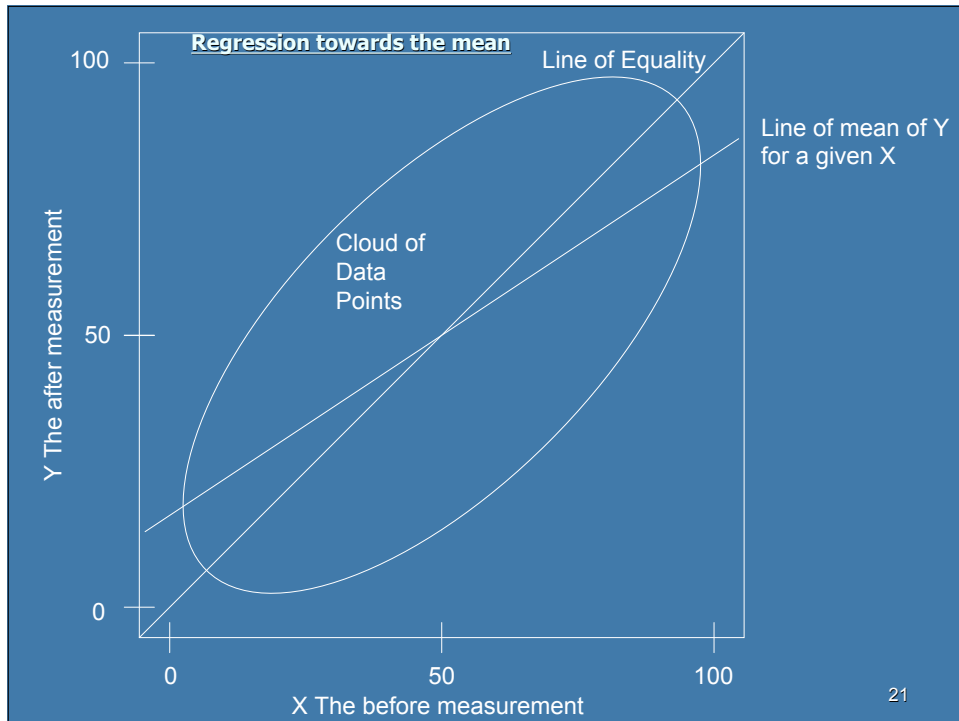
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Lack of Equivalence between Areas

Invariably it is the most crime-ridden area that gets the lighting, whereas the relatively crime-free 'control' area is not re-lit. So there is lack of equivalence at the start. One effect of this is to allow '**regression towards the mean**' to operate.

The name '*Control Area*' is a misnomer. '*Comparison Area*' is a better name.

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The response given to the lack of equivalence between the 2 areas. (RTM)

- Farrington and Welsh (2006) claim that RTM is a not problem because the effect in counted crimes in 250 Police 'Basic Command Units' going from 2002/3 to 2003/4 showed only small effect (a few %). This is hardly surprising as the areas and hence the number of crimes counted are an order of magnitude larger than in HORS251 so the year to year correlation is expected to be higher than for the small lighting study areas.
- Note Wrigley (1995) "This tendency for correlation coefficients to increase in magnitude as the size of the areal unit involved increases has been known since the work of Gehlke and Biehl (1934)".

Estimation of the effect of RTM

- A simple model of crime rates suggests that the high year to year correlation typically 0.95 for the BCU data, would indeed give an effect of a few %.
- However the smaller areas used in CRI evaluation would be expected to have lower correlation
- Burglary data from a study of 124 areas has correlation of about 0.8 giving, all else equal, an effect 4 times larger comparable to the claimed lighting effect.
- Note: in general we don't know the correlation nor rates being compared for the lighting studies. However, we do know, whereas the crime rate ratio at the start is 1.40 for Dudley, that for Stoke is 2.51 giving a much larger expected RTM effect.
- Without better knowledge we can't judge the impact of RTM but the indications are that it could be serious.

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Dissemination Bias 1

- One the problems of synthesising research findings is that 'positive results' tend to be more visible than those that aren't.
- Gives a distorted view of reality and suggests that more interventions are more effective than they actually are. (This has been studied particularly in the health field.)
- It is hard to know the effect of this in the study of crime. Statistical detection of such bias is possible given a sufficient sample of studies.
- Note: the authors of HORS251 could not obtain 5 reports of lighting trials.

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Dissemination bias 2

- It is important to obtain all relevant research, e.g. including the 'grey literature'.
- Need have detailed protocols for research and register of protocols, so it is easier to know the outcome of research. Need public access to this.
- Note the WHO is setting up the International Clinical Trials Registry. We need to know key information including interests and funding.

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Cost benefit analyses

- Cost benefit analysis has been done based on very few studies by lighting and crime researchers (and gives a highly favourable result for lighting). However doing this only increases the problem. As an unknown, unproven benefit/harm is being compounded with uncertain costs.
- We need to get much better information to do such an exercise properly otherwise it tends to look 'scientific' to the eye of a novice, when in fact it isn't, because of flimsy data and method.

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My 'Interest'

"...Paul Marchant, statistician at Leeds Metropolitan University who argues that statistics used in the Home Office Study 251 could equally be used to show that street lighting actually increases levels of crime. This is an argument which the APPLG, alongside the ILE, would hope to show as utterly absurd. Of course it is worth noting that Paul Marchant is also an astronomer as well as being a statistician, and that this may lead to some bias in his interpretation of the statistics he refers to."

P56 of the March/April 2004 issue of the Lighting Journal, the magazine of the Institution of Lighting Engineers.

APPLG = The All-Party Parliamentary Lighting Group
ILE = The Institution of Lighting Engineers

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My take on lighting and crime

- It may be that lighting reduces crime, or may be it increases crime. We have to look at the evidence as given. The conclusion, at present, is: We do not know....yet we ought to know in order to spend money rationally
- Note, I know of no scientific trials of exterior 'Security' lighting. So it is not known if these work.
- We ought to take a 'Popperian' view and entertain the possibility of light being ineffective or worse, against crime.
- Of course we all need light at night, to see by. (Those concerned about light pollution are basically talking 'lamp-shades'). However there is no sound evidence we need light to protect us from crime, in spite of claims.

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Wider problems of inappropriate methods

- The costs of crime and attempts at its reduction are large.
- Similar problems probably exist for the evaluation of other area-based crime reduction interventions, too. E.g. Unit of analysis, RTM.
- Methods Scales seems to suggest that weaker designs than RCTs might suffice, without indicating what is lost. This is problematic.
- We need to have proper evidence to decide 'what works' in crime and in all spheres.

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Much can be borrowed from methods in health research

For example in area-based crime reduction
The Methods of Cluster Randomised Trials are appropriate.
See e.g.
Ukoumunne et al (1999)
and
Campbell et al (2004)....CONSORT extension for Cluster
Randomised Trials.

Also, post-implementation monitoring is highly desirable for any programme.

(Note; it is problematic enough to determine What Works in healthcare where the 'unit' is 'person', through e.g. dissemination bias.)

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Some considerations for evaluation of anything

- Interventions are expensive, as are the consequences, so their effects need to be researched to a very high standard ,e.g. the necessity of using randomisation, blinding, wherever possible.
- Also the target population could be depleted through poorly conducted studies.
- Statistical issues need to be treated properly.
- Caution is needed with systematic reviewing/meta-analysis as it involves moving away from the primary sources.
- It should be possible to do 'roll out' in a way that is amenable to proper scientific evaluation.
- 'Foster scepticism' (Gorard). Warrants for research are necessary. Can research findings be plausibly explained by means other than that given by the researcher?

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High standards are needed for evidence

Need adequate funding to provide quality research, as the costs of rolling out programmes on a national scale are huge. Need to be aware of the costs of implementing ineffective or counterproductive programmes.

- Pre-publication of protocols. Register of protocols and trials.
- Open-access in order to check any work.
(As, for example, reports/papers may confuse standard deviations and standard errors or not recognise correlated data.)
- Let's have the raw data.
- Sound use of statistical methods needed. Engage statisticians.
- Need longer-term monitoring of interventions to see how things work out in practice. High scientific standards are needed here too.

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Final Quotes

Stephen Senn "Trust nobody, check everything" from 'Fear and Loathing in Pharmaceutical Statistics', Royal Statistical Society Conference 2002

HG Wells "Statistical thinking will one day be as necessary for efficient citizenship as the ability to read and write".

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