

Crime Science:

Foundations, Applications and Emerging Frontiers

Professor Kate Bowers

The first* home of Crime Science

* but certainly not only!

Our History:

We began in 2001 as the UCL Jill Dando Institute of Crime Science (JDI) after the murder of Jill Dando, BBC Crimewatch presenter

The UCL Department of Security and Crime Science was established in 2009

Our Research Centres:

UCL Centre for the Forensic Sciences

Dawes Centre for Future Crime

Centre for Global City Policing

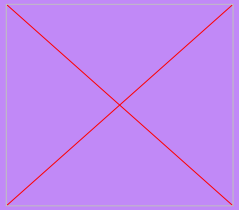
JDI Latin America and Caribbean Unit

UCL Security Science Doctoral Training Centre

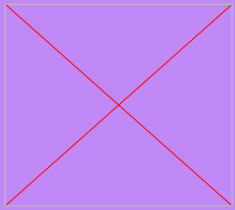
- ***Crime Science Immersive Lab***
- ***Forensic Science Evidence Interpretation Lab***
- ***Operational Technology Lab***
- ***CDT in Cyber-Physical Risk***



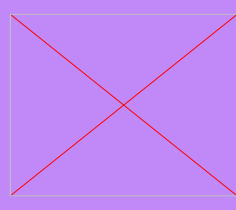
What research do we work on at UCL?



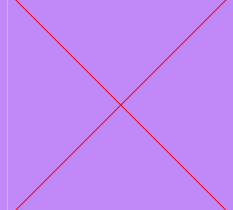
Crime
reduction



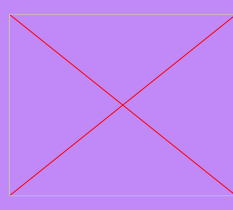
Spatial
crime
analysis



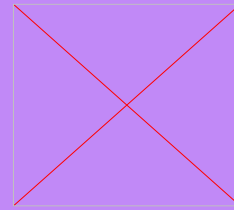
Cybercrime



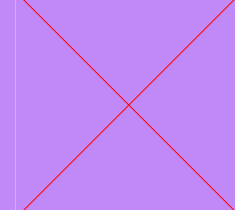
Forensic
science



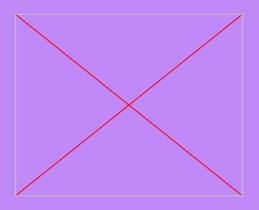
Policing



Human
trafficking
and
exploitation

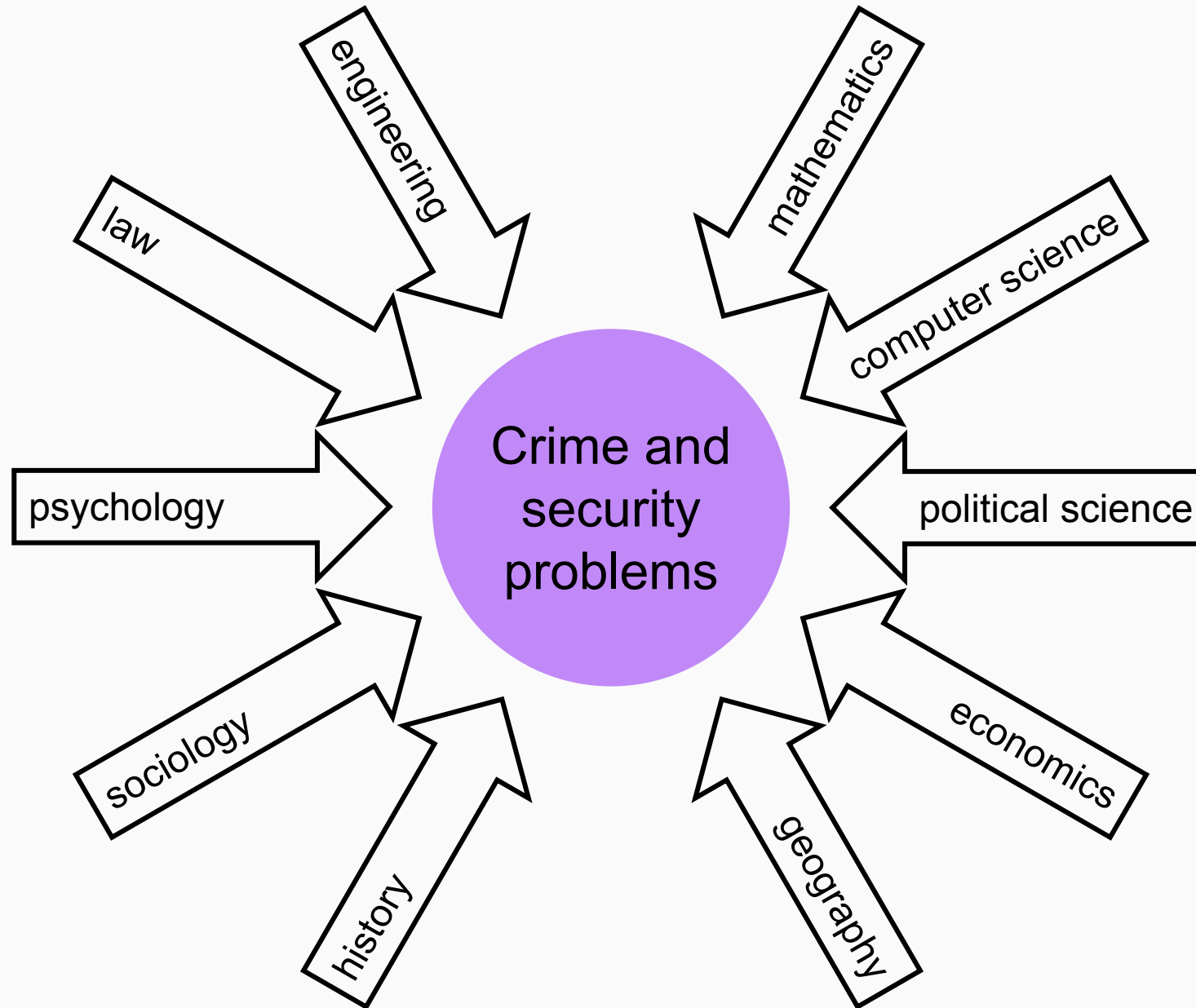


Terrorism
and
organised
crime



Future
crime

The Discipline of Crime Science



Ways that different disciplines can contribute

Discipline	Possible Contributions
Architecture	Crime-free housing
Biology	Genetic contributions to crime; forensic analyses
Chemistry	Drugs and explosives detection; forensic analyses
Computer Science	Cyber security; countering cyber crime; investigative analytics
Criminology	Understanding criminal justice processes
Economics	Policy modeling
Engineering	Surveillance and security technology
Epidemiology	Developmental causes of criminality
Geography	Crime patterns in time and space
Industrial Design	Designing products against crime
Mathematics	Crime modeling and simulations
Medicine	Treatments of biological disorders
Psychology	Developmental causes of criminality; offender decision making
Sociology	Social contribution to crime
Statistics	Analysing crime data
Town planning	Crime-free urban design

What else makes crime science different?



We are dedicated to:

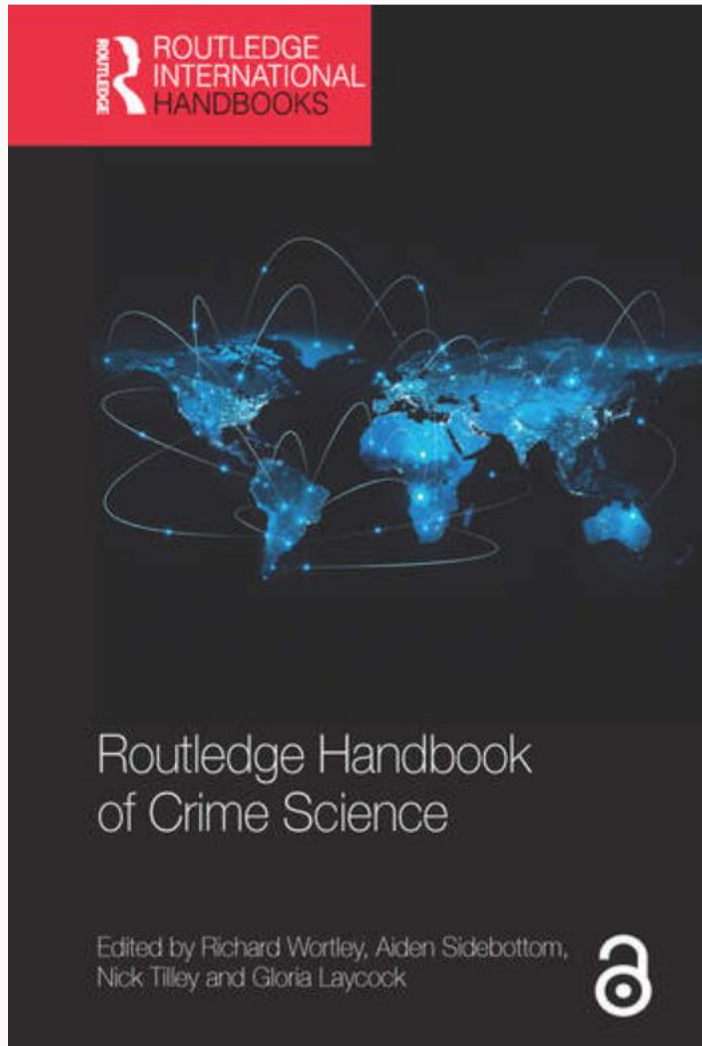
- Bringing disciplines together from across the social and physical sciences
- Finding new and sustainable ways to reduce crime and security problems
- Thinking about crime and security in a scientific way, using innovative methods and systems thinking
- Working directly with policymakers, police and related agencies to have real world impact

Crime scientists as multi-disciplinary researchers and engineers



- The humility and objectivity of science
- Engineering approach
 - “problem-solving and research development where what happens now builds on what happened yesterday, to extend success and to identify and remedy failures”*
- Building evidence bases in crime science, security science, forensics, counter-terrorism and cyber crime

Defining crime science

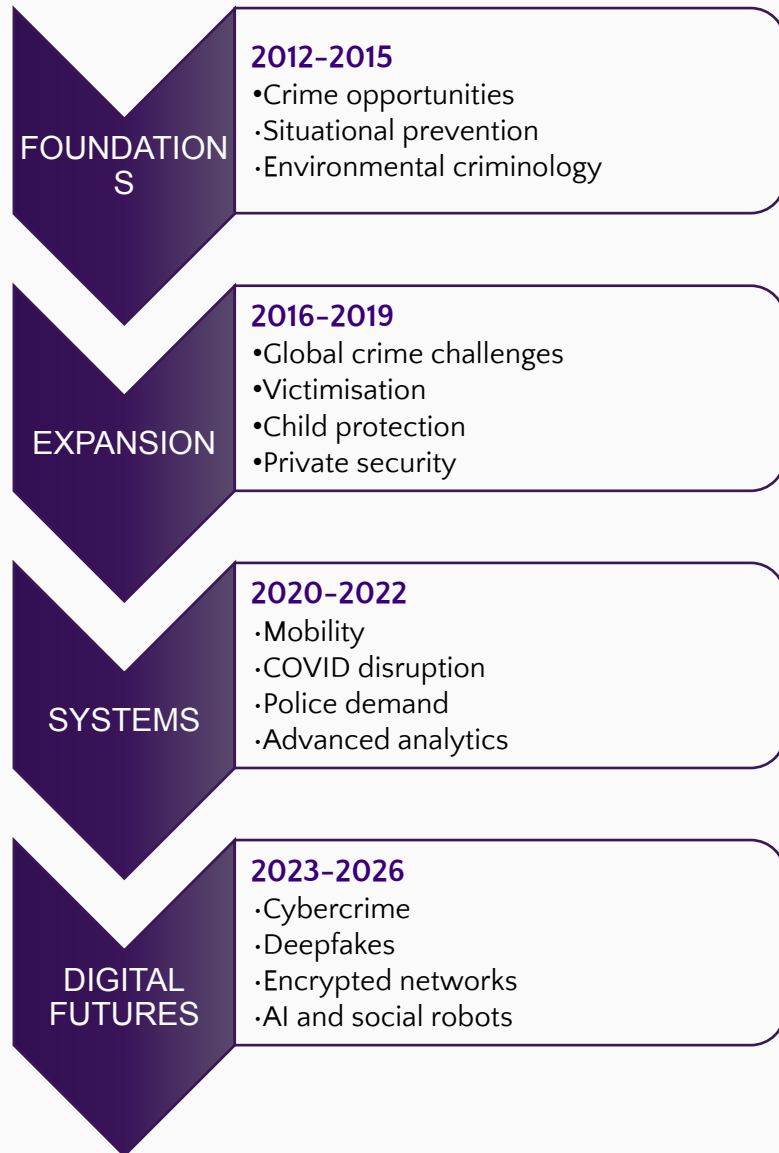


“Crime science is the application of scientific methods and knowledge from many disciplines to the development of practical and ethical ways to reduce crime and increase security.”

Wortley, R., Sidebottom, A., Tilley, N., & Laycock, G. (2019). *What is crime science?* In R. Wortley, A. Sidebottom, N. Tilley, & G. Laycock (Eds.), *The Handbook of Crime Science*. London: Routledge

AI Analysis of *Crime Science Journal* articles

From Crime as Opportunity to Crime in Complex Systems

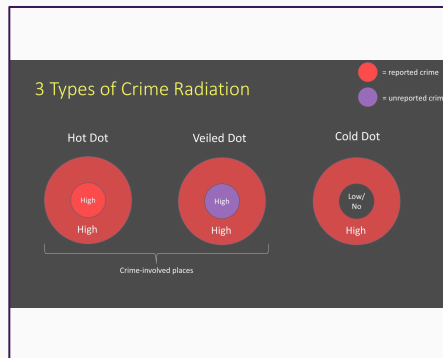


Key Trends in *Crime Science* (2012-2026)

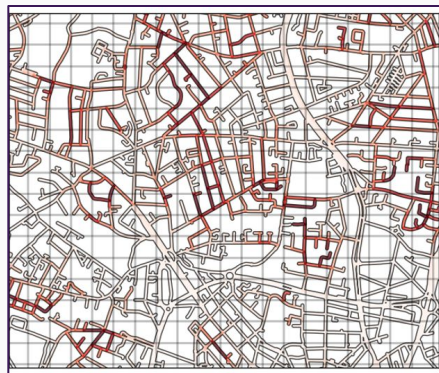
1. Strong continuity around opportunity and prevention
2. Growing sophistication in analytical methods
3. Expansion from physical places to complex systems
4. Increasing focus on victims and harm
5. Rise of cybercrime and digital threats
6. Strong commitment to practical impact

Themes of the Crime Science Journey

Illustrations from collaborative research



Enduring core:
opportunity,
prevention,
environmental
criminology



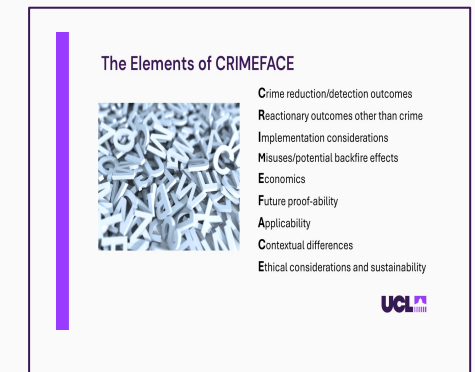
Methodological growth: mapping,
modelling,
forecasting,
network analysis



Broadening focus:
policing, security,
victimisation,
public safety



Consistent mission:
evidence for crime
reduction and
prevention



New frontiers:
cybercrime, AI,
digital harms,
encrypted
networks

1. Enduring Core: Building opportunity theories of crime



Provo, Utah

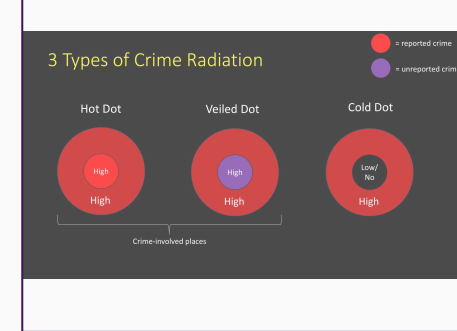
Established theories:

- Crime Pattern Theory
- Routine Activity Theory
- Rational Choice Theory

A theory under refinement:

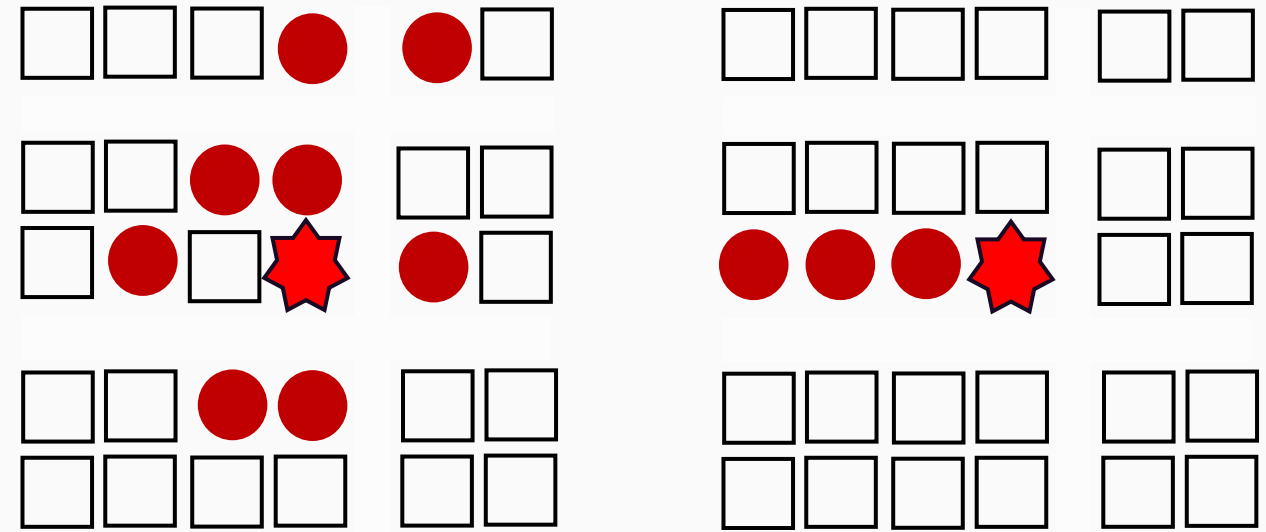
- Crime Radiation Theory

Collaborators: Shannon Linning and John Eck



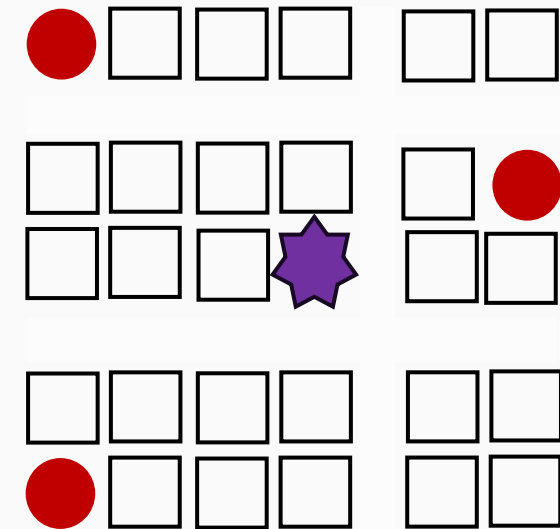
Definition

- Crime radiation occurs when a place elevates the risk of crime at other places nearby.
- Place = proprietary place (address)



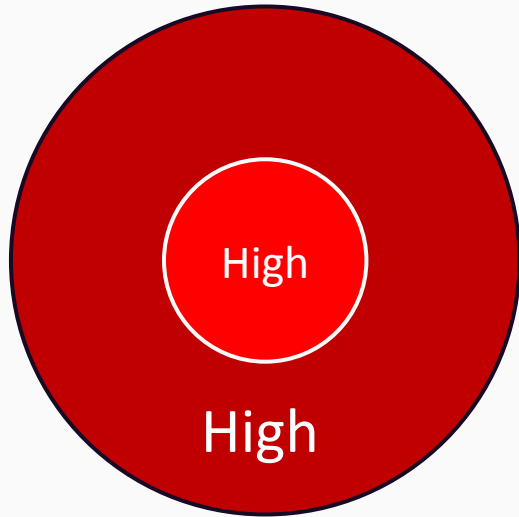
Circular

Linear

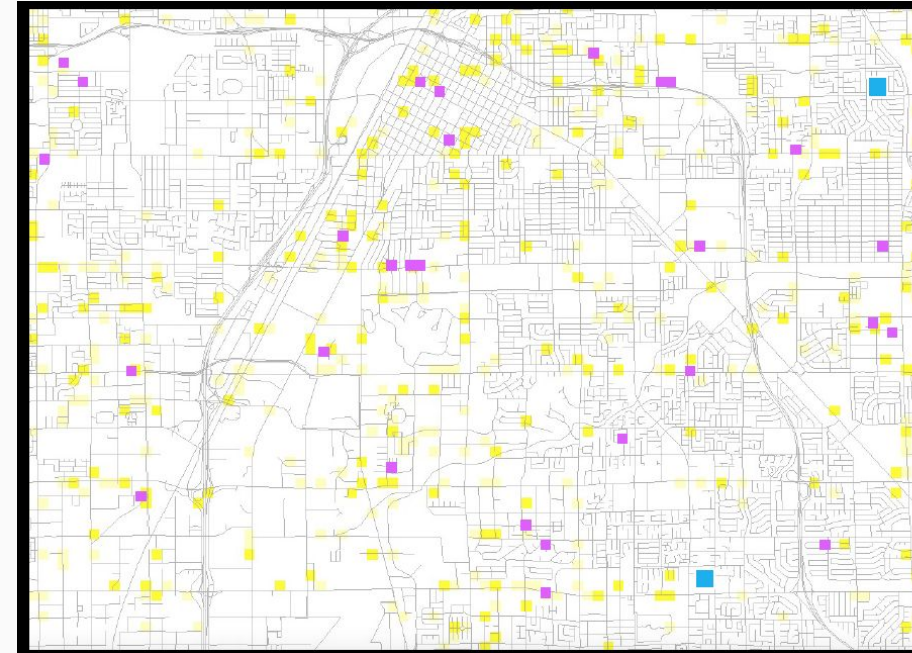
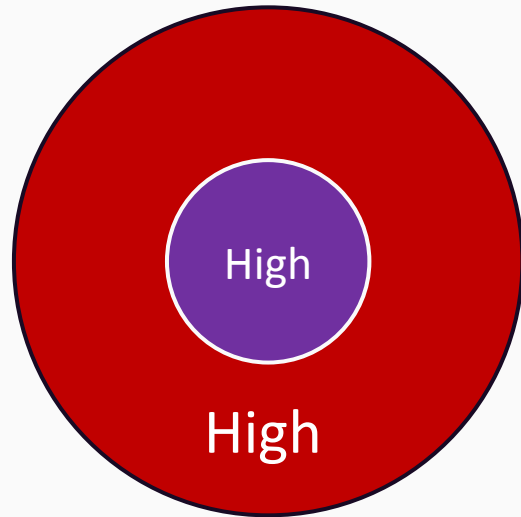


Far

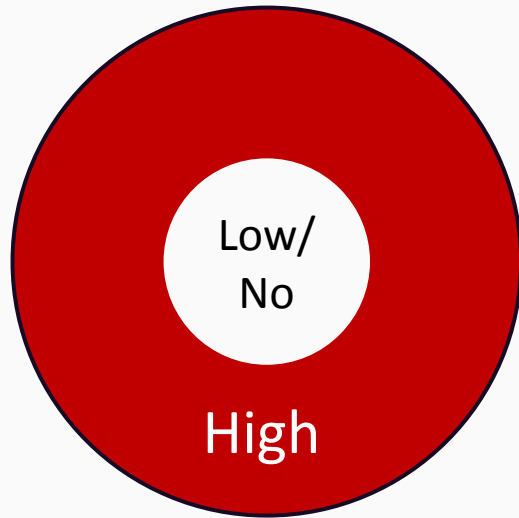
Hot Dot Radiation



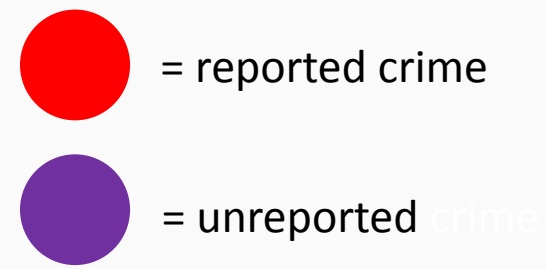
Veiled Dot Radiation



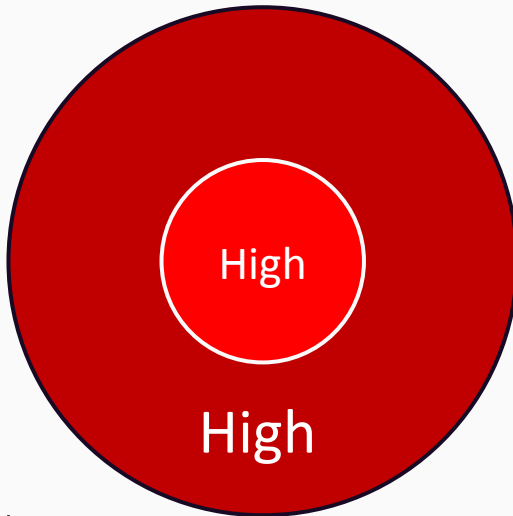
Cold Dot Radiation



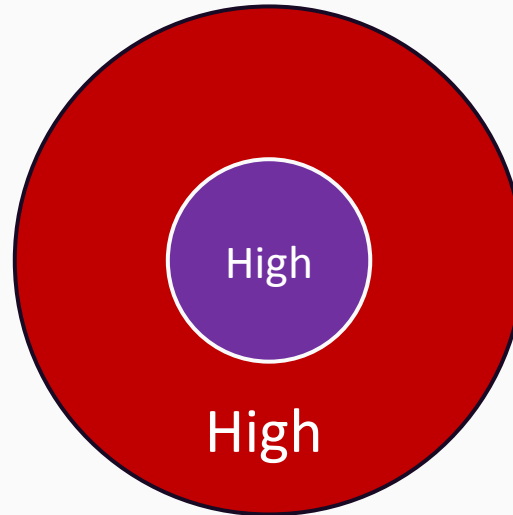
Types of Crime Radiation



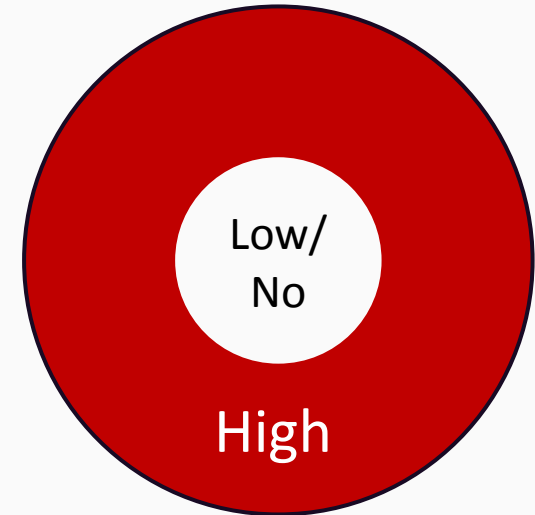
Hot Dot



Veiled Dot



Cold Dot



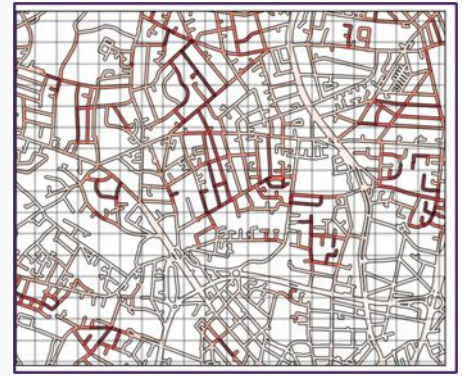
Crime-involved places

Source: Linning, Bowers and Eck (2024)

Mechanism: Anchoring



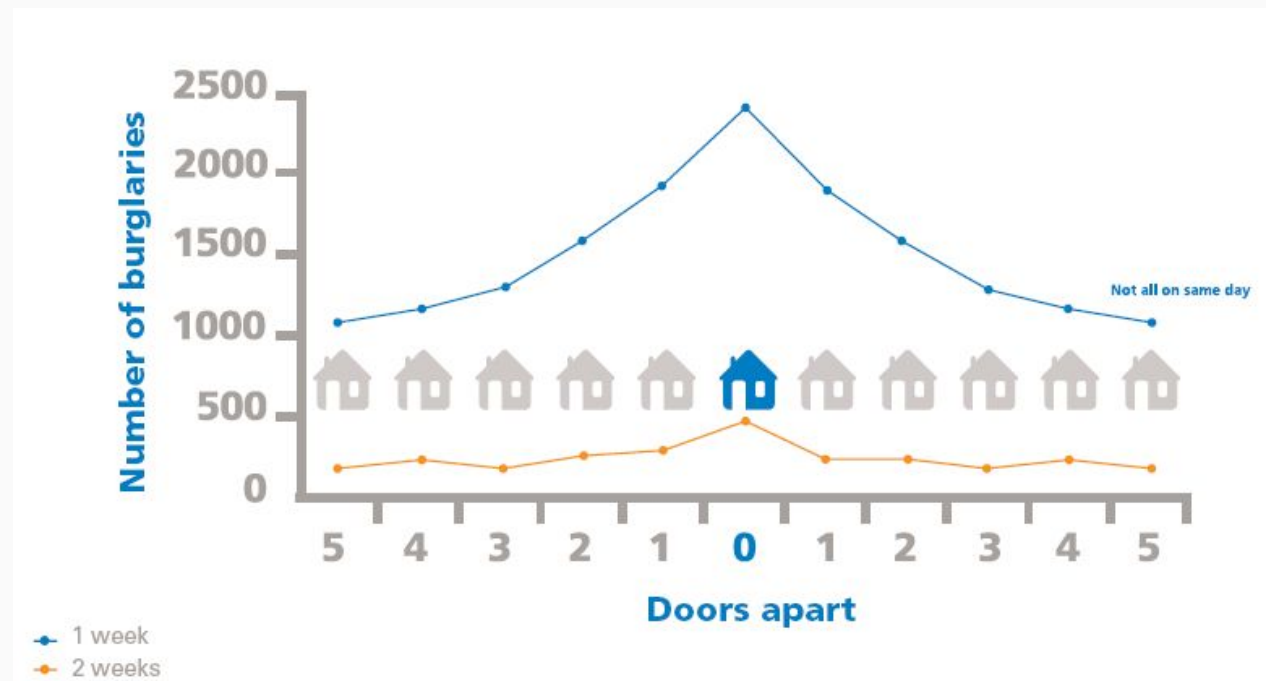
2. Methodological growth: Improving crime forecasting and police patrol routing



- Improving the forecasting power of crime maps
- Designing efficient policing patrol
- Merging data sets to improve police routing

Collaborators: Shane Johnson, Toby Davies, Ken Pease, Gabriel Rosser and Tao Cheng.

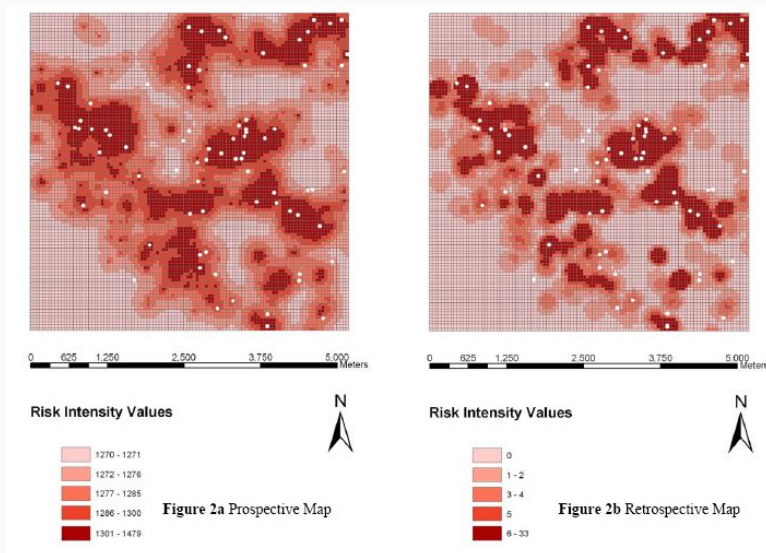
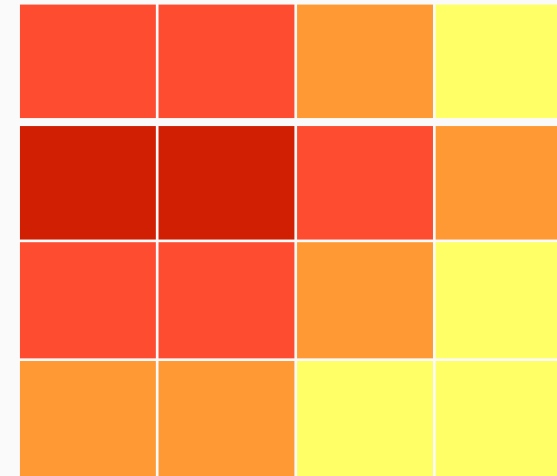
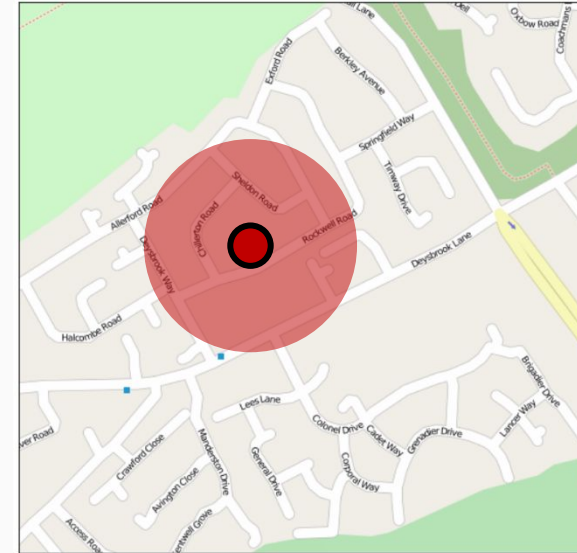
Evidence for Neighbour effects ('Near Repeats')



Source: Bowers and Johnson
(2005)

Crime Prediction

- Space-time kernel density estimation (grid- or planar-based)
- Top 20% of cells- 'standard' KDE captured 46% of burglaries and 'promap' captured 62% of burglaries in following 2 days



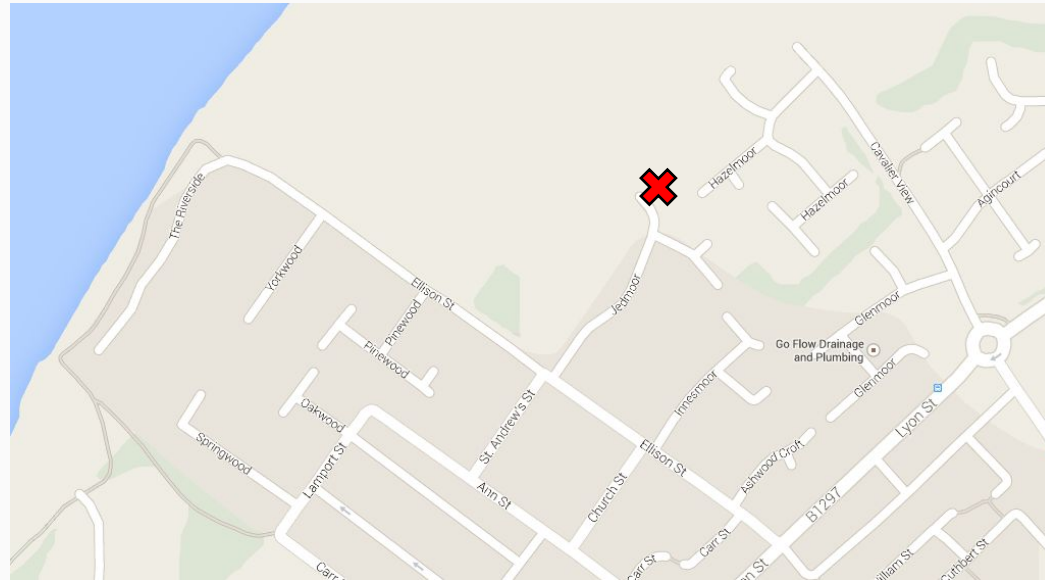
Source: Bowers, Johnson and Pease (2004)

Risk diffusion on networks

- Targets are arranged on the street network
- For offenders, the street network determines what is 'near'
- Spread of risk is not uniform in space

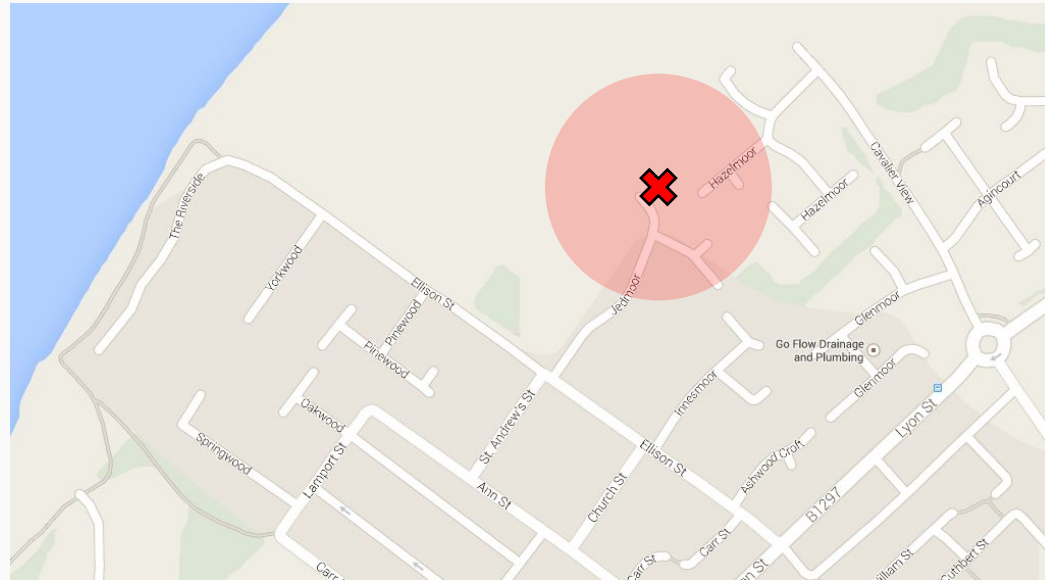
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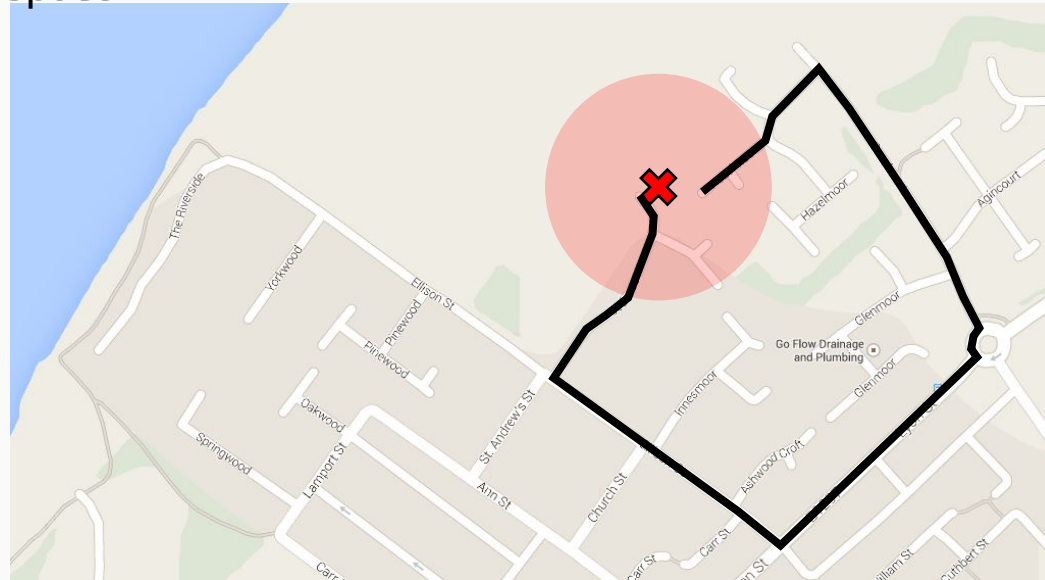
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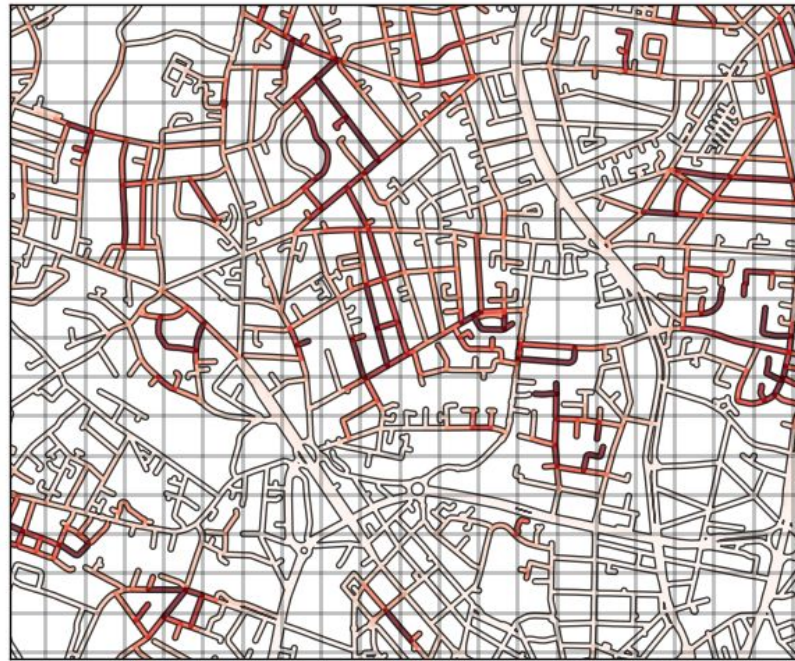
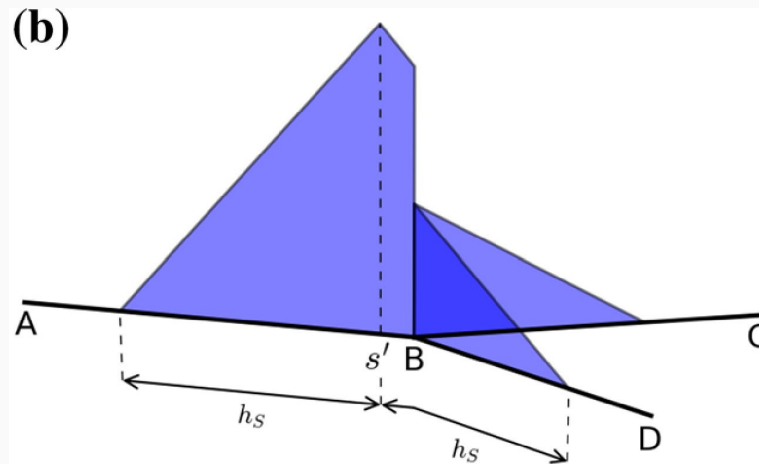


Risk diffusion on networks

- Targets are arranged on the street network
- For offenders, the street network determines what is 'near'
- Spread of risk and offender awareness is not uniform in space

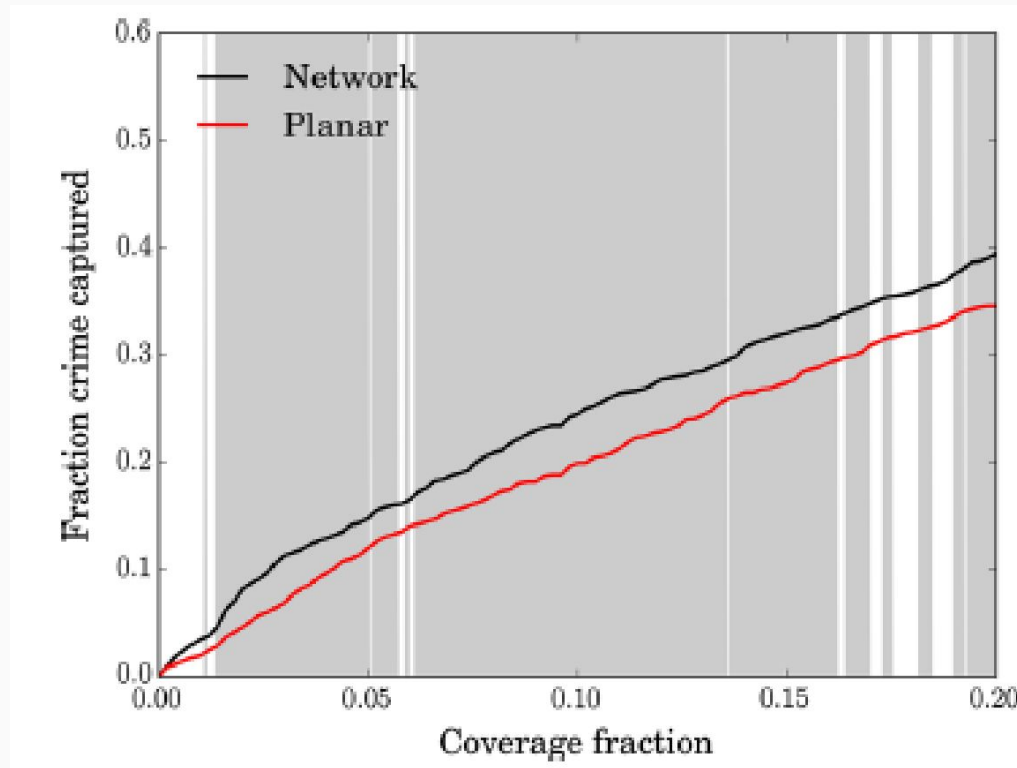


Predictive Output (Burglary)



Source: Rosser, Davies, Bowers, Johnson and Cheng (2016)

Comparing Predictive Accuracy



Background shading indicates where the Network KDE has a significantly higher hit rate than the planar

Source: Rosser, Davies, Bowers, Johnson and Cheng (2016)

Using GPS Data to look at general supply and demand



Policing provision

- To what extent is policing activity aligned with the distribution of incidents requiring response?

SUPPLY

Total duration of police vehicle presence.



Policing provision

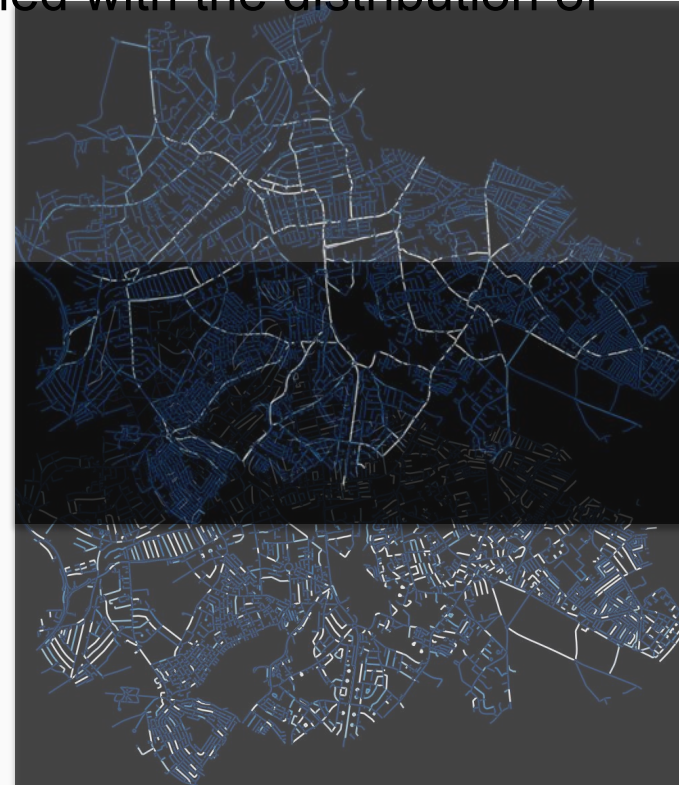
- To what extent is policing activity aligned with the distribution of incidents requiring response?

SUPPLY

Total duration of police vehicle presence.

DEMAND

Total volume of calls for service generated.



Policing provision

- To what extent is policing activity aligned with the distribution of incidents requiring response?

SUPPLY

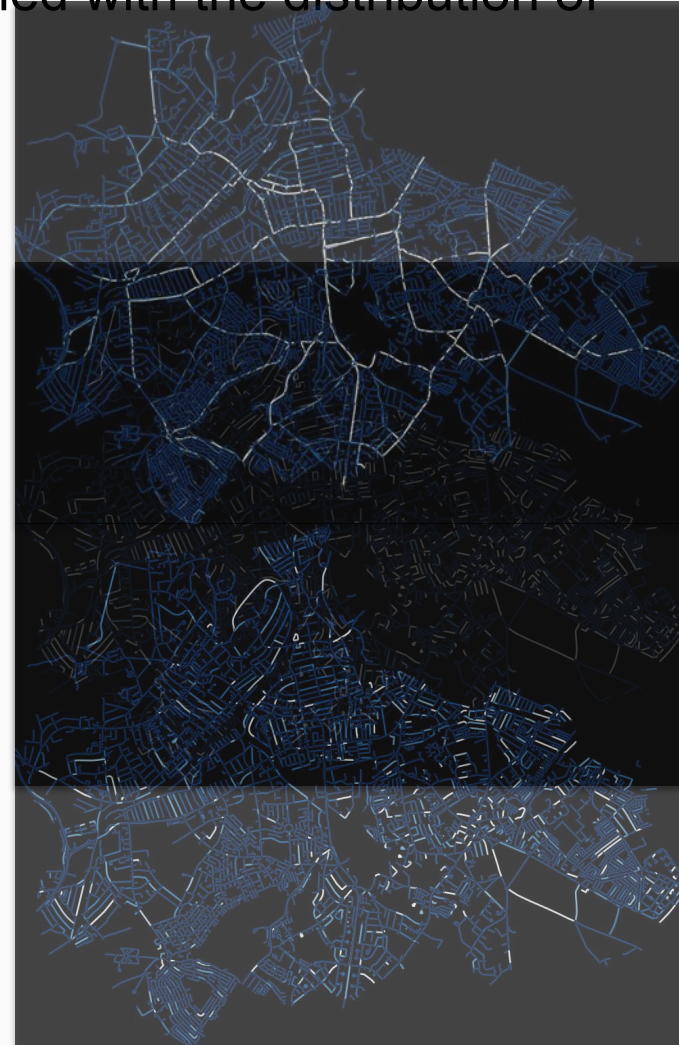
Total duration of police vehicle presence.

DEMAND

Total volume of calls for service generated.

PROVISION

Imbalance between supply and demand.



Over-provision

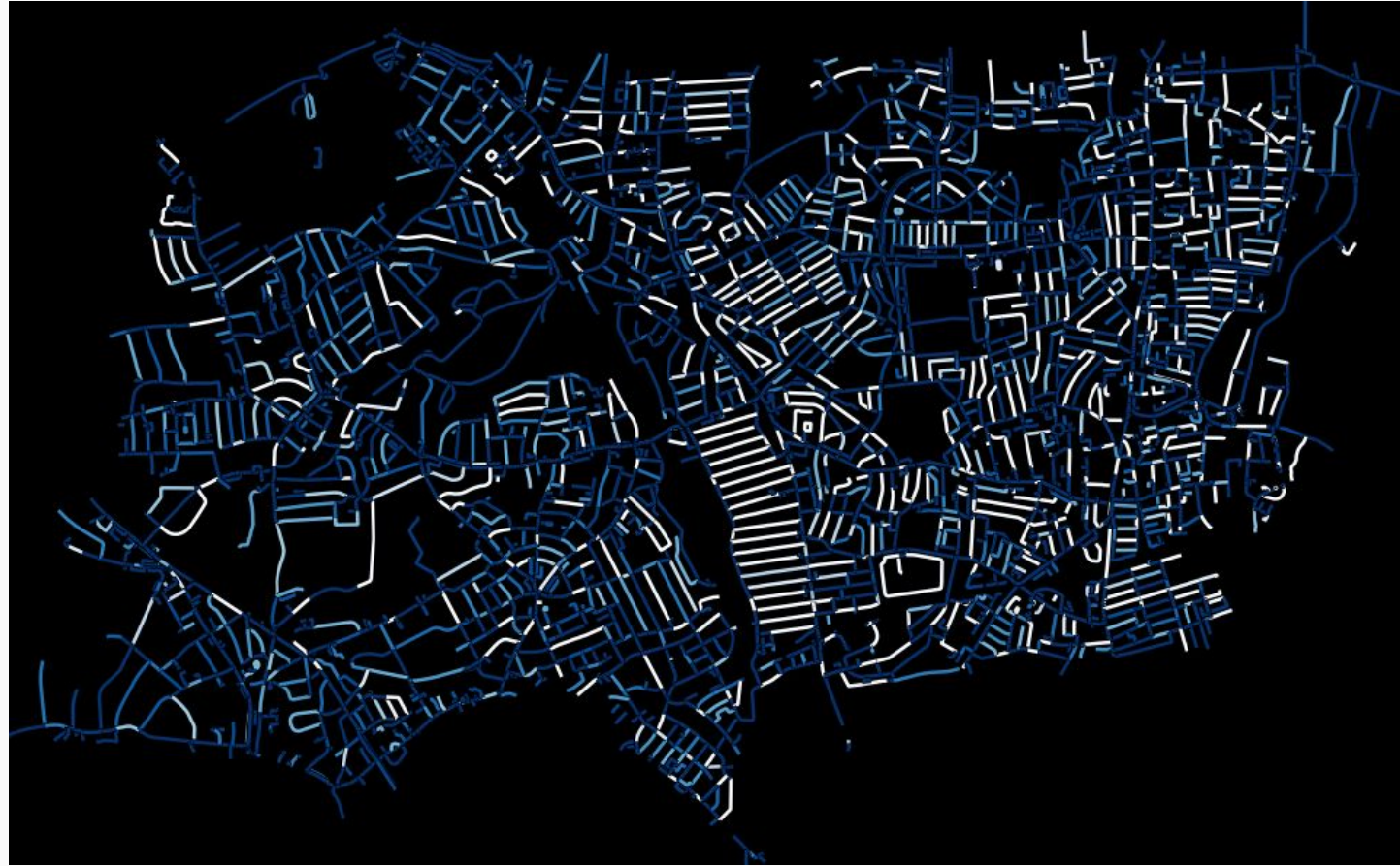
Haringey



Source: Davies and Bowers (2020)

Under-provision

Haringey



‘Unexplained’ over-provision

Brent



‘Unexplained’ under-provision

Brent

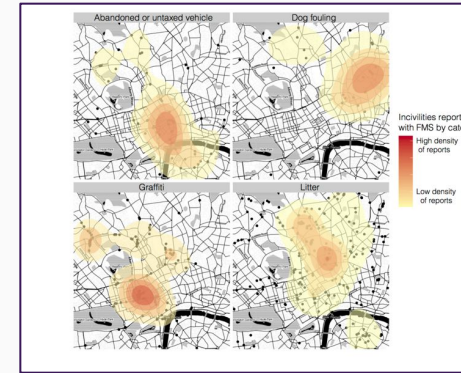


‘Unexplained’ under-provision

Brent



3. Broadening Focus: Considering Public Safety



- Fear of crime is often discussed as a static trait of individuals
- In reality, people feel different levels of fear depending on their situation and context
- How can we test this empirically?

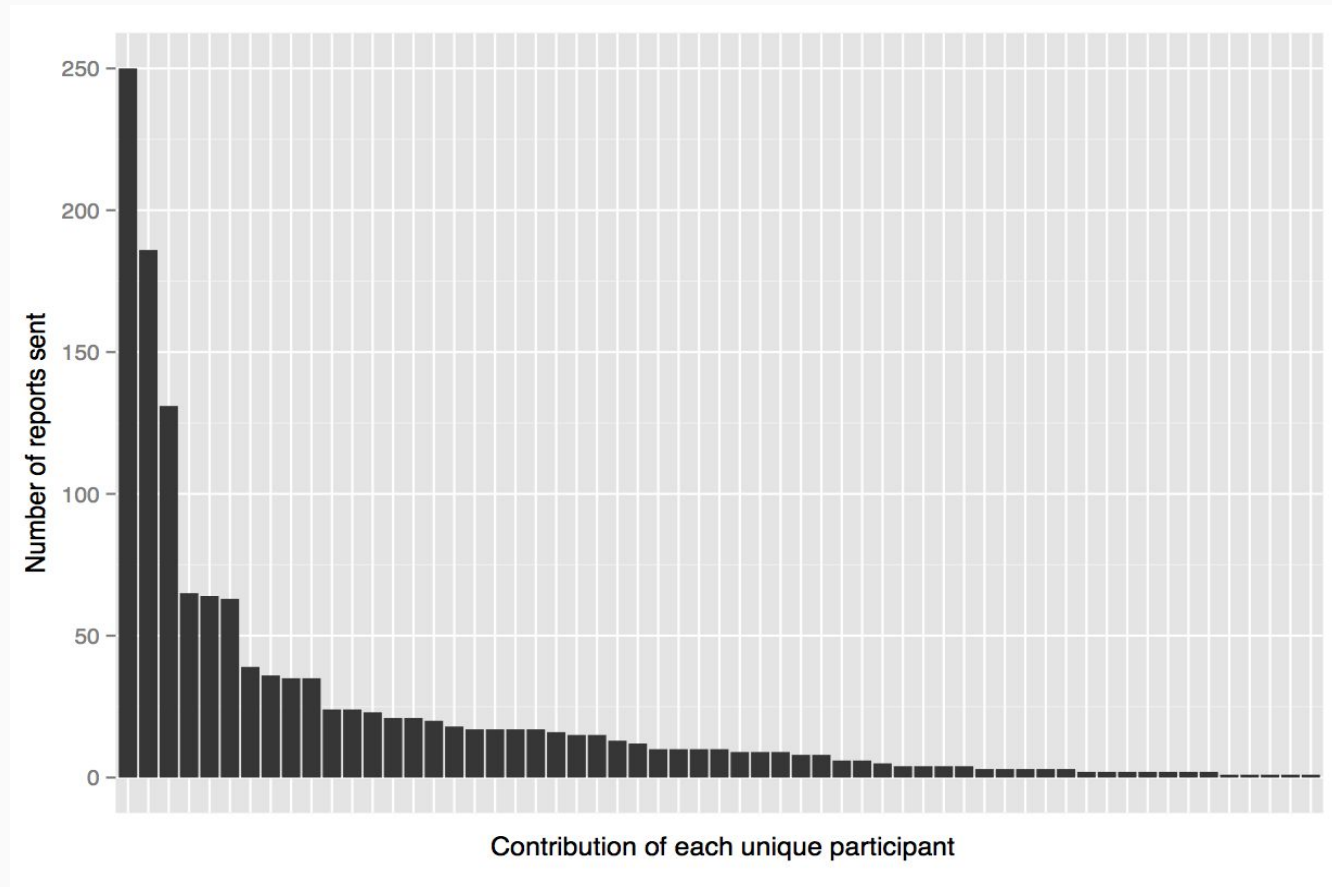
Collaborators: Reka Solymosi and Taku Fujiyama

Measurement issue in Crime Science: Fear of crime



- Fear of crime is traditionally measured by survey as a static trait of individuals
- Mobile phone app developed to collect information on how concerned about safety people were in *different settings*
- Used a volunteered geographical information approach- crowdsourcing and participatory mapping
- Opportunity sample
 - 4 months with 59 participants

Number of responses sent by each participant



Source: Solymosi and Bowers (2018)

Fluctuation is seen in levels of worry

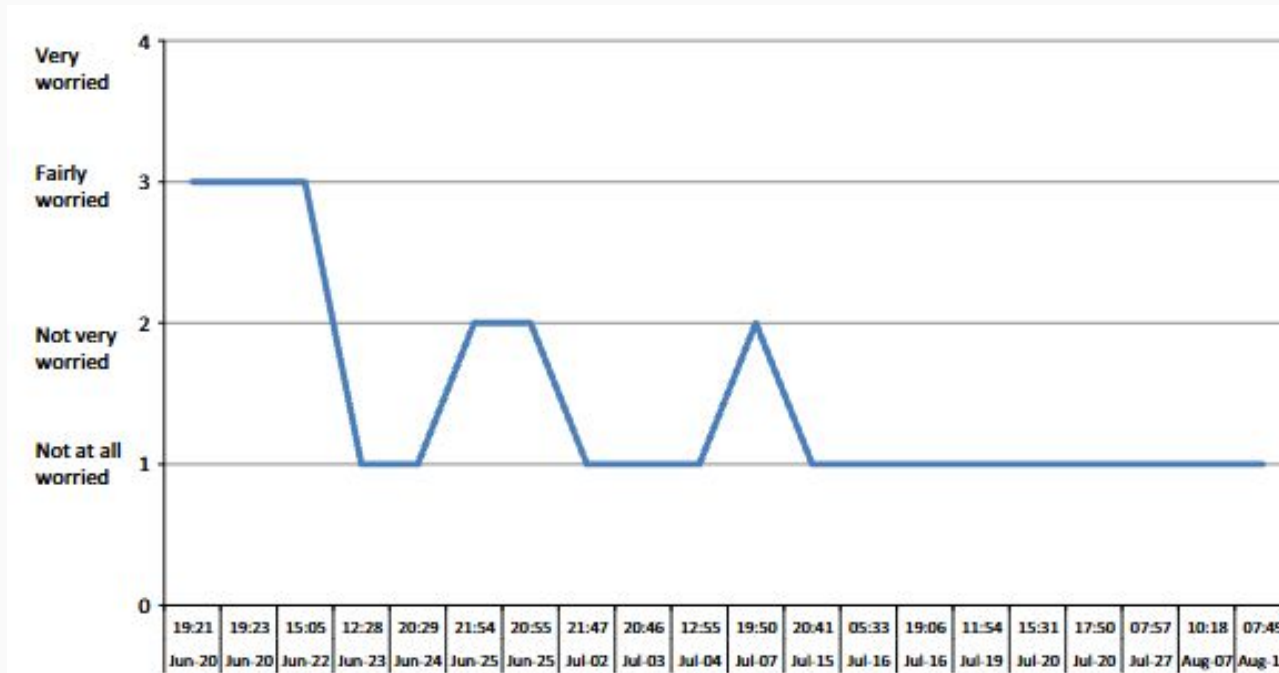


Figure 4. One participant's fear of crime over the trial period (1 = Not at all worried, 4 = Very worried)

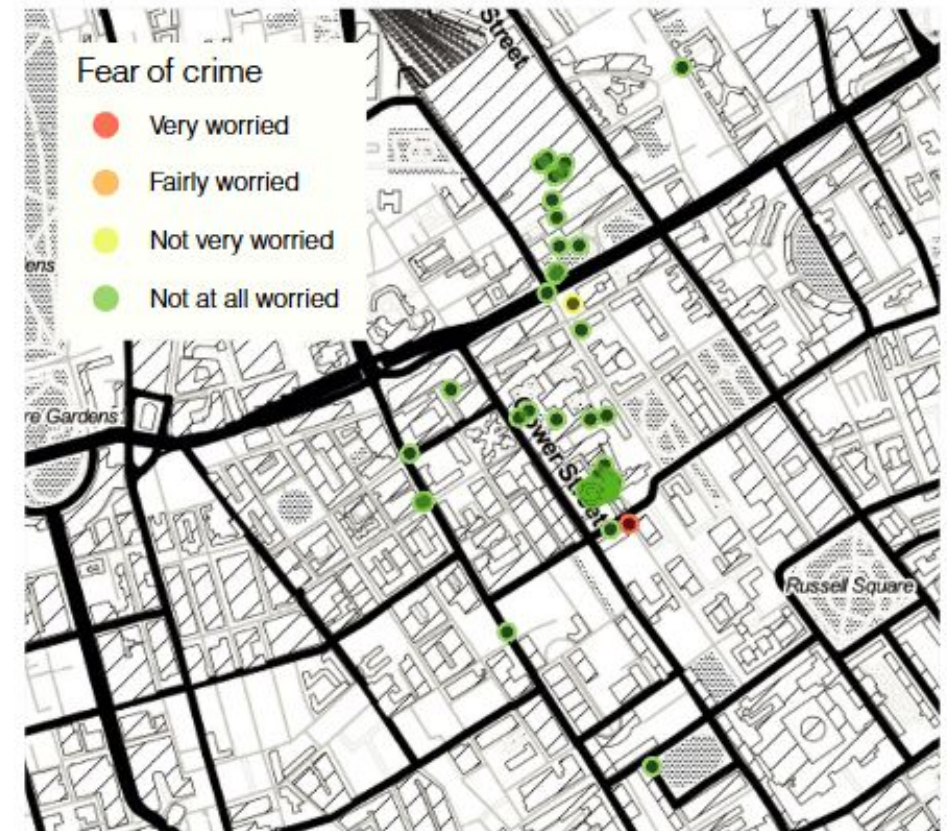


Figure 5. Detail in one individual's fear of crime map.

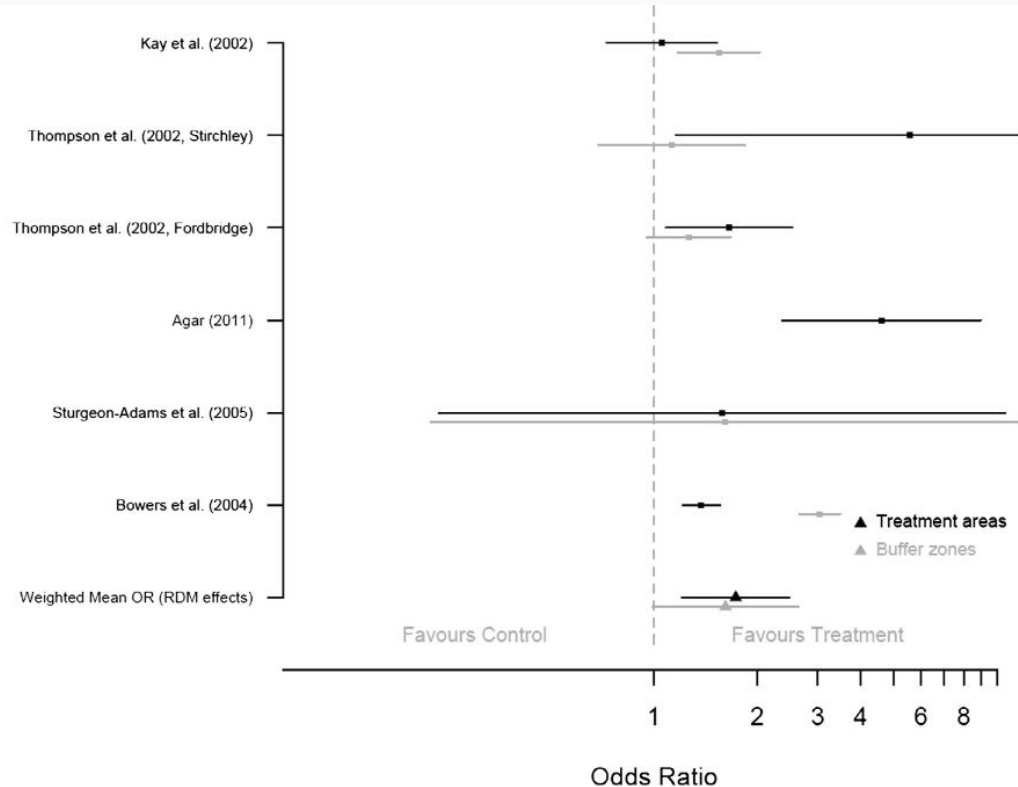
Source: Solymosi, Bowers and Fujiyama (2015)

Hotspot map of different incivilities in central London- a new fear of crime approach?



Source: Solymosi and Bowers (2018)

4. Consistent Mission: Evidence for Crime Prevention



What evidence do we need to plan crime prevention?

Meta-analysis traditionally used to synthesise quantitative data on effect from multiple evaluations – to make statements on ‘what works’

But it is safe to assume it will work for us?

Collaborators: Many colleagues at UCL and a consortium of UK universities, UK College of Policing



EMMIE: What decision-makers need to know

E*ffects* found (did it work?)

M*echanisms* producing effects (how did it work?)

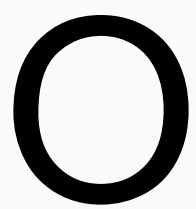
M*oderators* influencing mechanism activation

I*mplementation* challenges

E*conomy* (costs and returns on investment)

Source: Johnson, Tilley, and Bowers (2015)

A classic evaluation design



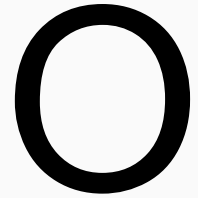
Performance measure
before intervention



Intervention

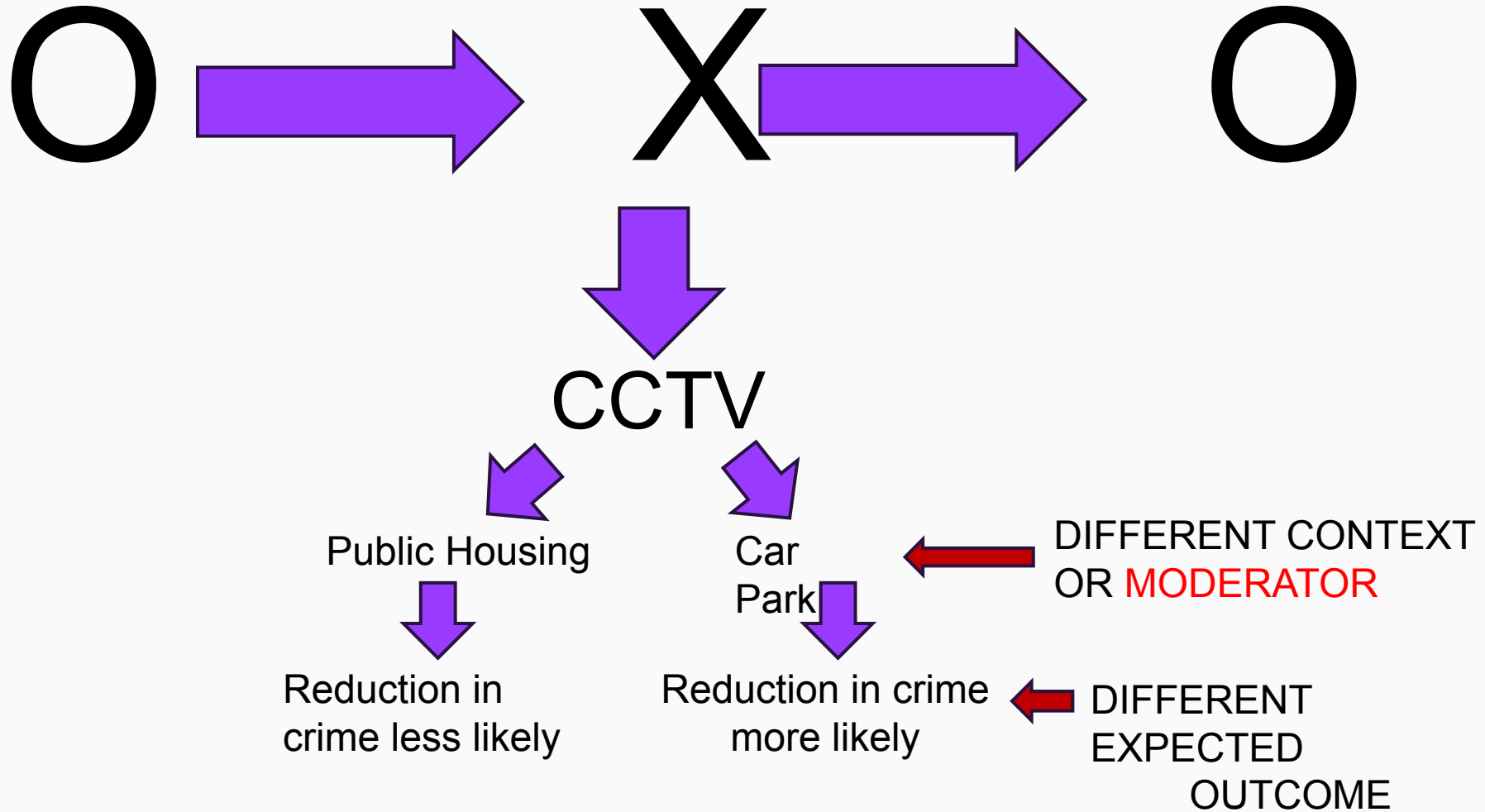


after intervention

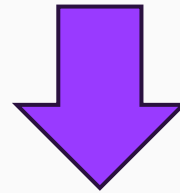
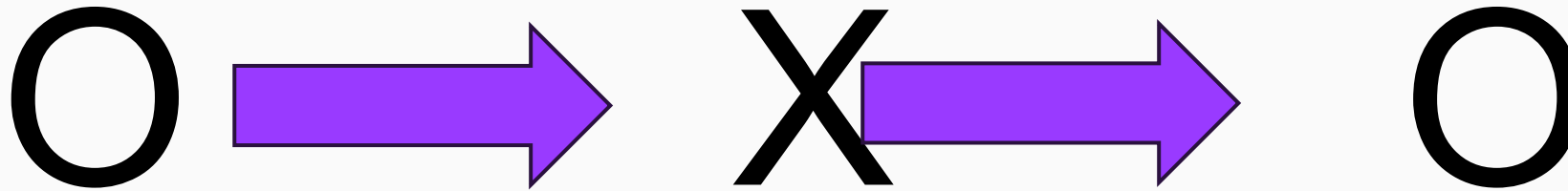


Performance measure

EMMIE 'unpacks the X'



EMMIE 'unpacks the X'



Hotspot Policing Patrol

Problem- Oriented
Policing



Reduction twice
that of traditional
patrol likely

Traditional
Patrol



Modest reduction
in crime more
likely

DIFFERENT
IMPLEMENTATION PLAN

DIFFERENT
EXPECTED
OUTCOME

Home / Crime Reduction Toolkit

Our effect scale

Our quality scale

About the Crime Reduction Toolkit

Key

Quality of evidence



Filters

Impact on Crime

(select a range using the markers below)



Search term...

Go

Crime Reduction Toolkit

Intervention	Impact on crime	How it works	Where it works	How to do it	What it costs	
	Effect	Mechanism	Moderator	Implementation	Economic cost	
Alcohol ignition interlock	✓✓	⚙️	📍	?	£	📌
Alcohol tax and price policies	✓✓	⚙️	📍	?	£	📌
CCTV	✓✓	⚙️	📍	?	£	📌
Cognitive Behavioural Therapy (CBT) for Domestic Violence	✓	⚙️	📍	?	£	📌
Correctional boot camps	X✓	⚙️	📍	?	£	📌
Criminal sanctions to prevent domestic violence	X✓	⚙️	📍	?	£	📌

5. New Frontiers: The need for CRIMEFACE in facing the future of crime



- New/future technologies create opportunities for crime *and* its reduction that require careful consideration.
- Police adoption of new technologies requires the consideration **of multiple categories of evidence**, encapsulated by the acronym CRIMEFACE.

Source: Bowers and Johnson (2024)

“what do the police actually need to know about a new technology to use it effectively?”

How not to do it?

New York mayor calls off 'creepy, alienating' police robo-dog

- 'Digidog' to be returned to creator Boston Dynamics
- Ocasio-Cortez praises activists who fought its deployment

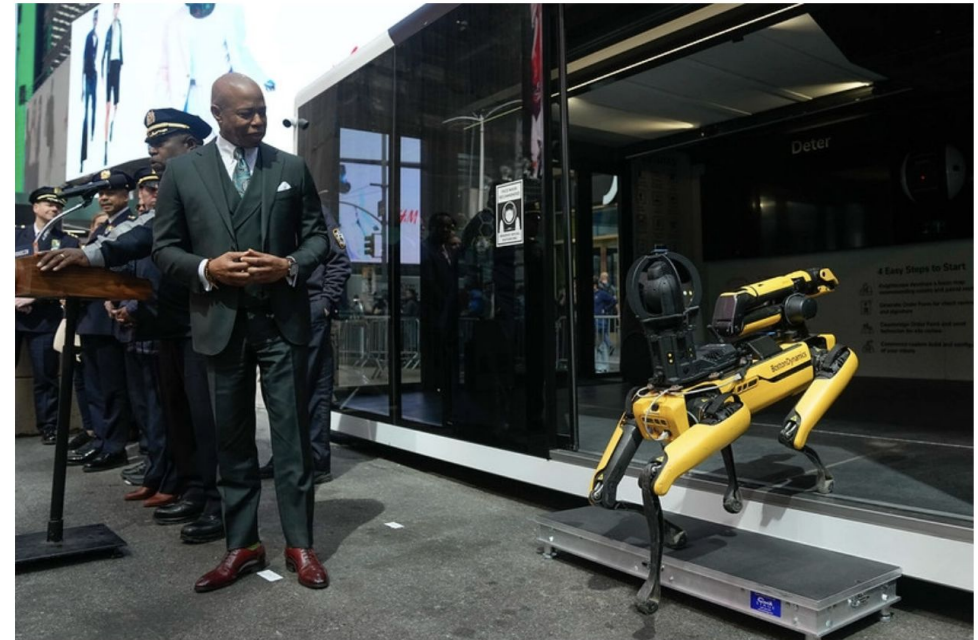


📷 The dog, similar the Boston Dynamics dog pictured above, sparked an immediate backlash, with critics noting police dogs have been traditionally used to suppress and intimidate communities of color. Photograph: Reuters

NEW YORK

'Digidogs' are the latest in crime-fighting technology. Privacy advocates are terrified.

Local law enforcement is getting cash from the feds to purchase high-tech tools that raise new questions about civil liberties.



NYC Mayor Eric Adams unveils a yellow and black version of the NYPD's new robotic police dog. | New York City Mayor's Office

The Elements of CRIMEFACE



CCrime reduction/detection outcomes

Reactionary outcomes other than crime

Implementation considerations

Misuses/potential backfire effects

Economics

Future proof-ability

Applicability

Contextual differences

Ethical considerations and sustainability

Trust in Digital Technology: 'CRIME'

CRIME

Does or is the technology likely to reduce crime or improve its detection?

REACTIONS

What are the likely reactionary outcomes for:

1. Perceptions of legitimacy (will the public accept it)?
2. Public Trust (will the public engage with it)?
3. Explainability (can the public easily understand it)?

IMPLEMENTATION

How easy is integration with current systems?

What are the knowledge expertise requirements?

Does it need a security protocol change? That is a change to policing security culture?

MISUSES

What is the potential for misuse or backfire effects?

ECONOMICS

What is the likely value for money and cost-effectiveness?

What is the likely return on investment?

Trust in Digital Technology: 'FACE'

FUTURE USE

Will it stay current or go obsolete quickly?

Will future use or updates be costly?

APPLICABILITY

Are there clear mechanisms for crime reduction and detection?

Are there clear mechanisms for reactionary outcomes such as public trust?

Is the technology relevant to multiple crime scenarios and crime types? How adapted is it across problems?

CONTEXT

What are the contextual differences in implementation, crime outcome and public reaction?

Is effective operation highly context dependent?

ETHICS

What are the ethical considerations including:
Transparency
Proportionality
Is it Non-discriminatory and unbiased?
Does it comply with DPA?
Are the ethical implications evaluated?
Environmental impact including sustainability and carbon costs.

The Applications of CRIMEFACE



NPCC Office of the Police Chief Scientific Adviser (OPCSA) are developing the approach for practice:

1. Considering the role of CRIMEFACE elements in:

- Project and evaluation design
- Project reporting and reflective learning
- Organising and synthesising evaluation evidence
 - Producing logs for innovations and interventions
 - Producing scalability advice

2. Developing new CRIMEFACE collection tools and guidance.

Crime Science elements and implications for safer cities



1. **Enduring Core:** opportunity theories

- **Example:** Crime Radiation Theory
- **Demonstrates:** Systems thinking approach
- **Implication:** Encourage place management

2. **Methodological Growth:** data science methods

- **Example:** Crime Forecasting
- **Demonstrates:** Interdisciplinarity
- **Implication:** Use predictive maps to more accurately direct policing to demand.

3. **Broadening Focus:** beyond policing

- **Example:** Tracking fear of crime
- **Demonstrates:** Innovative data and methods
- **Implications:** Focus effort on environmental contexts that make people fearful.

4. **Consistent Mission:** crime prevention

- **Example:** Crime Reduction Toolkit
- **Demonstrates:** Collaboration between academia and practice
- **Implication:** Evidence needs to provide implementors with knowledge relevant to local context.

5. **New Frontiers:** policing in a technological revolution

- **Example:** CRIMEFACE
- **Demonstrates:** Longer term thinking approach
- **Implication:** New factors are essential to address in 21st Century Policing

Key References for Illustrations

Bowers, K., & Johnson, S. (2024). Facing the future of crime: a framework for police use of technology. *The Political Quarterly*, 95(3), 480-488.

Davies, T., & Bowers, K. (2020). Patterns in the supply and demand of urban policing at the street segment level. *Policing and society*, 30(7), 795-817.

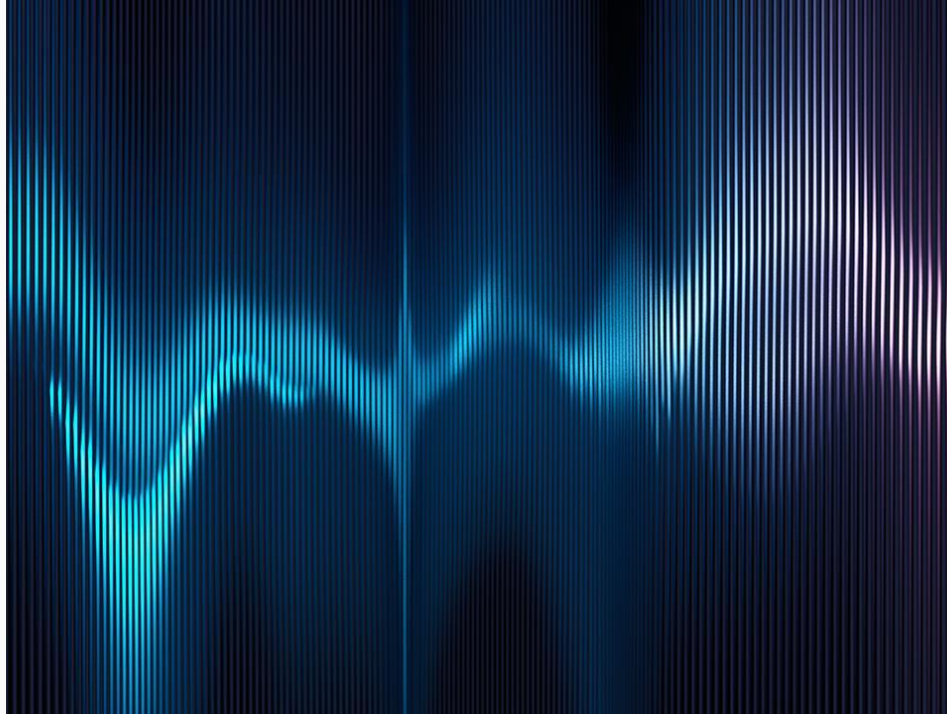
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Summary

'Crime science is the application of scientific methods and knowledge from many disciplines to the development of practical and ethical ways to reduce crime and increase security'

There are many fantastic examples of international research in crime science

Using a crime science approach advocates focusing on **real problems** and building **practical solutions** to make cities safer.