



# CPC: crime, policing & citizenship - overview

# TAO CHENG

# **Big Data and Intelligent Policing**

# CPC Project Closing Workshop

7<sup>th</sup> June 2016



# Challenges in policing

Crime is unevenly distributed in space and time

- Influenced by urban form
- Can be reconciled with offender decision processes

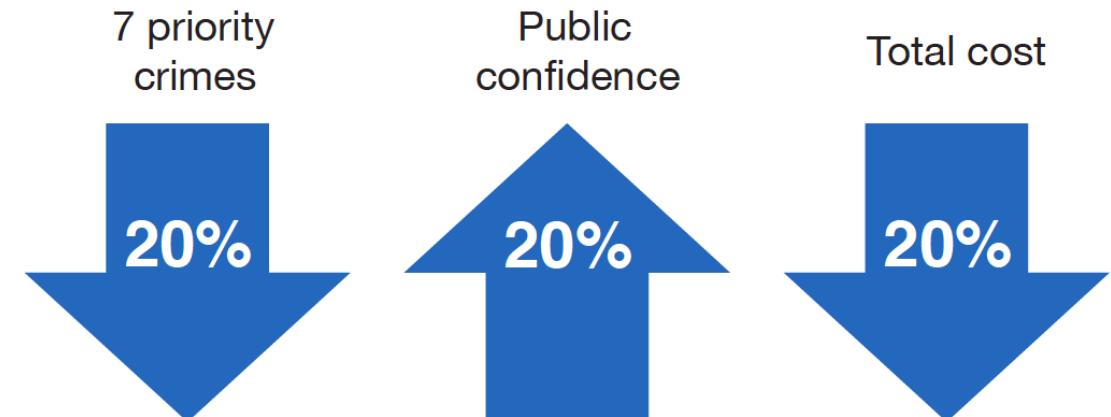


Citizens are changing

- Satisfaction varies significantly by time and location
- Confidence is dropping in some areas
- Consistent gap between perceived likelihood and actual prevalence of crime

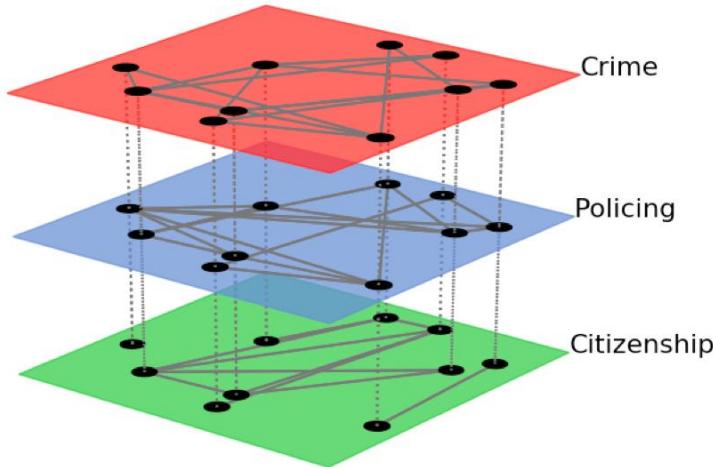
Policing is changing

- Changing demands
- Severe resource constraint
- Increased availability of technology



# Crime, Policing and Citizenship (CPC)

Space-Time Interactions of Dynamic Networks ([www.ucl.ac.uk/cpc](http://www.ucl.ac.uk/cpc))



**Aim:** Combine spatio-temporal modelling and statistical analysis, machine learning with network theory to **model the interactions** between **police activity, crime reporting, and public perception** of the police...

...to help improve local and city-wide policing.

(EPSRC, £1.4M, April 2012 – June 2016)

# **Intelligent data-driven policing (our definition)**

- Data-driven tools must be easy to use and translate straightforwardly into police action
    - Prediction and modelling should be network-based
  - Accuracy is paramount to improve police efficiency
    - A framework of accuracy evaluation is needed
  - Optimal management & coordination of resources
    - Tools for senior officer (strategic planning) & frontline officers (patrolling) are needed
  - The key role of feedback of policing strategies
    - Methods & tools for evaluation and refinement are needed

# Our approach

## Multi-disciplinary

- Geoinformatics; crime Sci, geography, computer Sci, mathematics

## Complexity theories

- Integrated spatio-temporal thinking and modelling
- Network based representation and analysis
- Mix approaches of machine learning, statistical regression and agent-based simulation

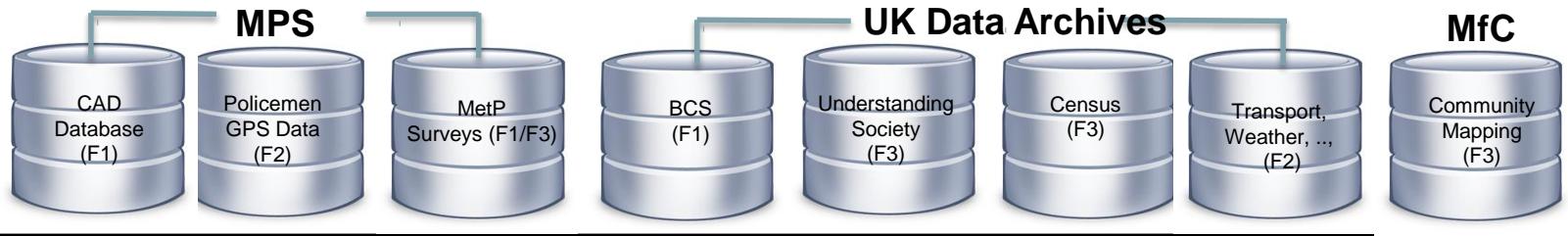
## Practical focus

- Close cooperation with Met Police Forces
- Test prototypes in MPS HQ

# Data & Methods

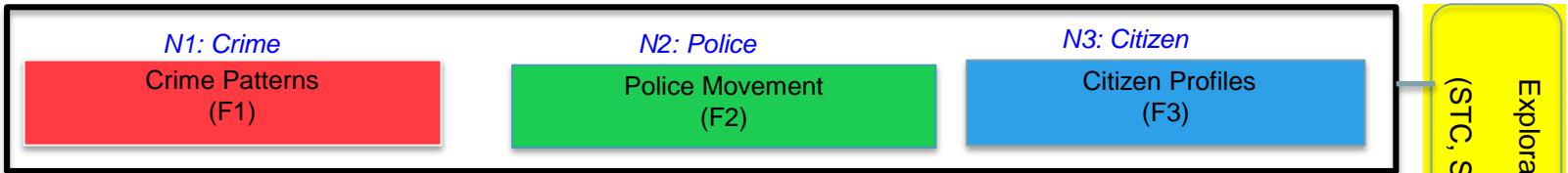
1 Month

Phase 1: Data Acquisition and Conflation



7 Months

Phase 2: Space-Time Patterns of Individual Networks



16 Months

Phase 3: Interaction of Networks



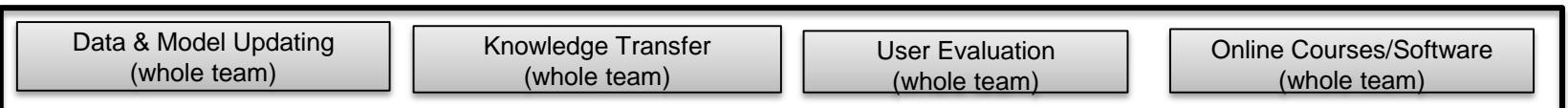
28 Months

Phase 4: Policy Evaluation



37 Months

Phase 5: A Web-base Platform for Dynamic Visualization and Simulation



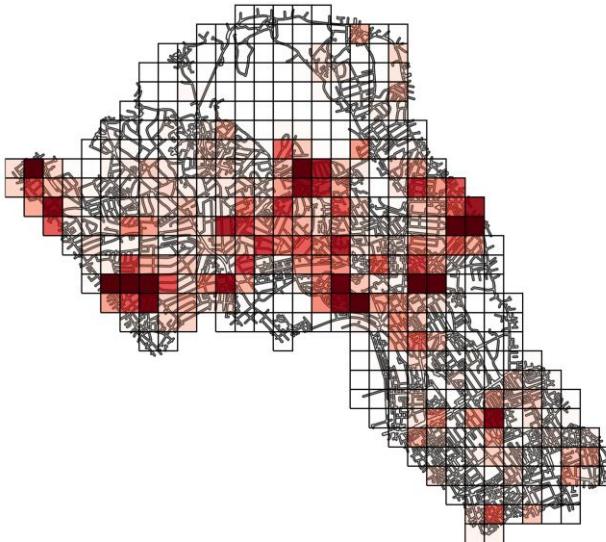
Exploratory Space-Time Analysis &  
Visualisation  
(STC, STSS; STK; STV, STB; ABM)

# Crime

## Policing

# Citizenship

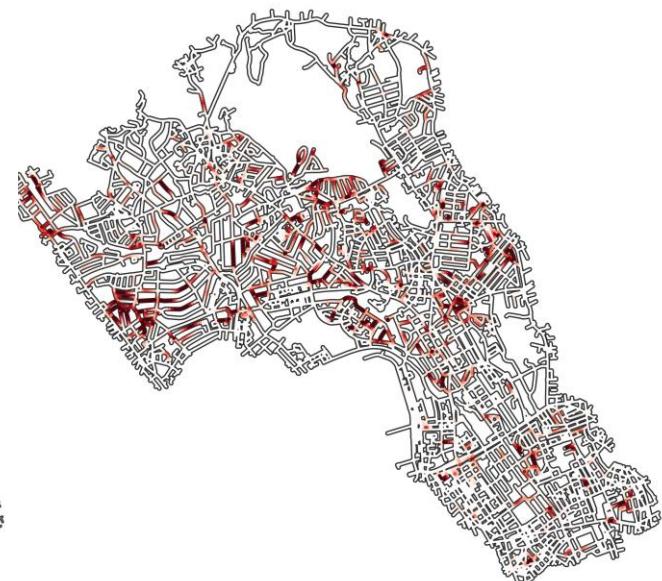
CPC has developed cutting edge algorithms for crime prediction



## Grid based

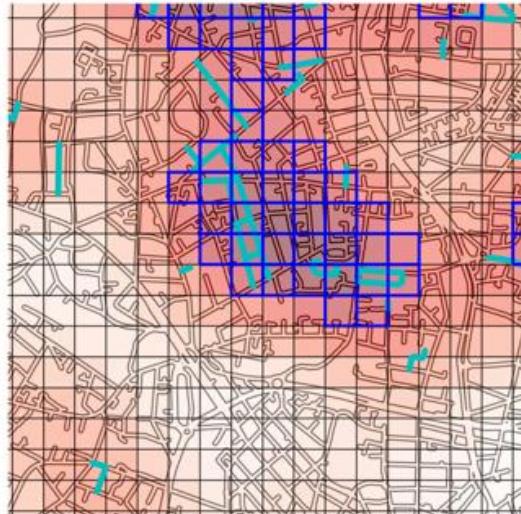
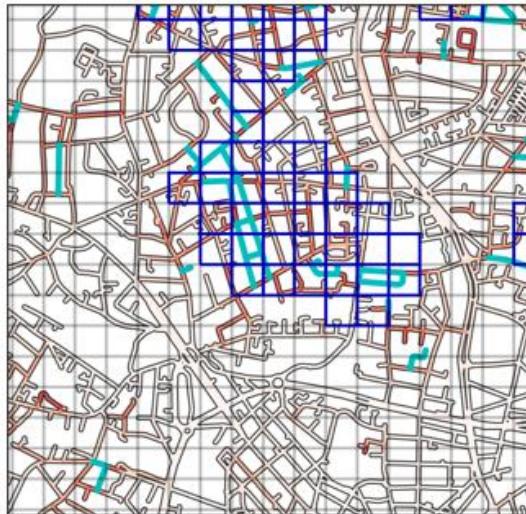


## Region based



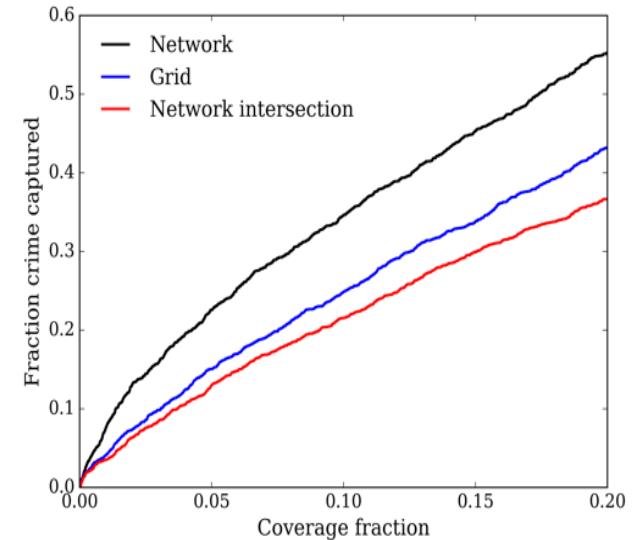
## Network based

# Network-based prediction (Gabriel Rosser)



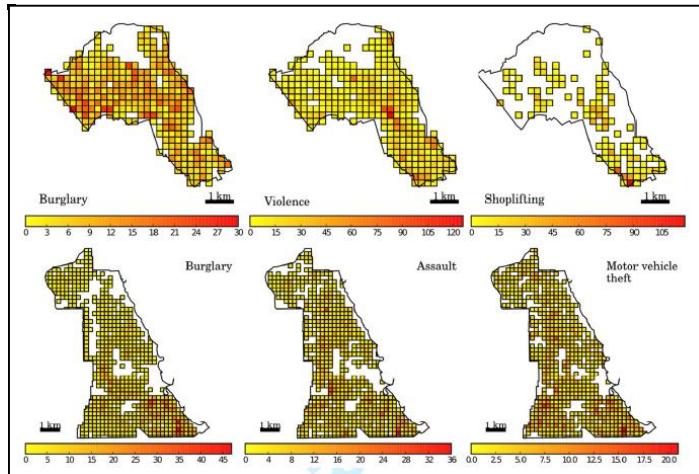
the top 5% most risky units are highlighted

a) network-based, and b) grid-based

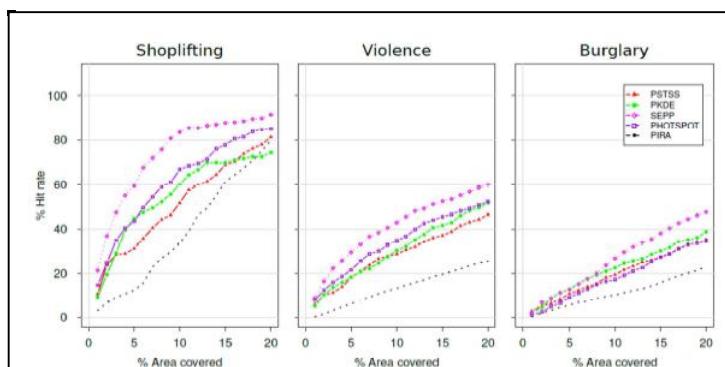


c) predictive ‘hit rates’ achieved

# Accuracy evaluation (Monsuru Adepeju)



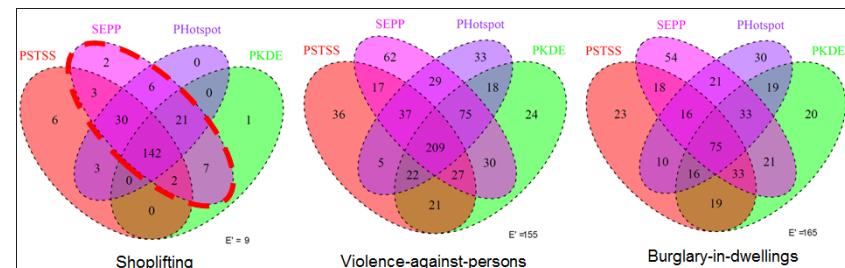
a. Case study of Camden and Chicago crimes dataset



b. Comparison of predictive accuracy over 20% area coverage (Camden)

Crime Type	Method	Accuracy		Hotspot compactness		Variability	
		Hit rate		CI		DVI	
		Mean	SD	Mean	SD	Mean	SD
Shoplift	PSTSS	81.3	27.6	0.42	0.04	14.9	11.0
	PKDE	74.3	29.8	<b>0.55</b>	0.04	2.7	1.7
	SEPP	<b>91.5</b>	20.1	0.31	0.03	6.0	2.1
	PHotspot	85.1	27.0	0.37	0.04	<b>19.2</b>	9.2
	PSRA	81.6	27.3	0.02	0.04	23.4	1.9
Violence	PSTSS	46.5	20.0	0.46	0.04	10.8	8.0
	PKDE	51.7	19.5	<b>0.54</b>	0.04	2.6	3.9
	SEPP	<b>59.7</b>	19.8	0.12	0.03	4.5	1.6
	PHotspot	52.2	19.9	0.32	0.05	<b>21.1</b>	6.7
	PSRA	26.3	18.5	-0.30	0.10	71.0	4.1
Burglary	PSTSS	34.4	22.0	<b>0.51</b>	0.05	3.7	5.6
	PKDE	38.8	24.2	0.50	0.07	2.3	1.9
	SEPP	<b>47.4</b>	26.3	0.02	0.05	1.4	1.2
	PHotspot	34.9	23.0	0.30	0.06	<b>5.3</b>	4.4
	PSRA	23.9	21.8	-0.34	0.10	72.2	4.2

c. Breakdown of performances of different predictive methods across different crime types for Camden case study



d. Complementarity

Crime

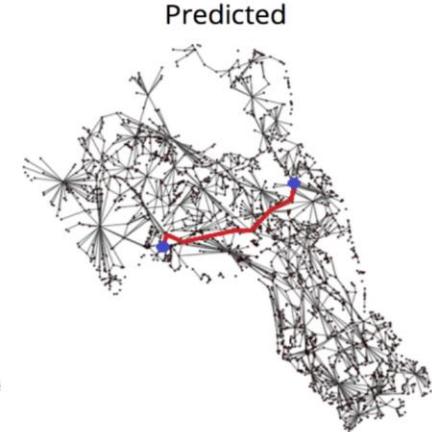
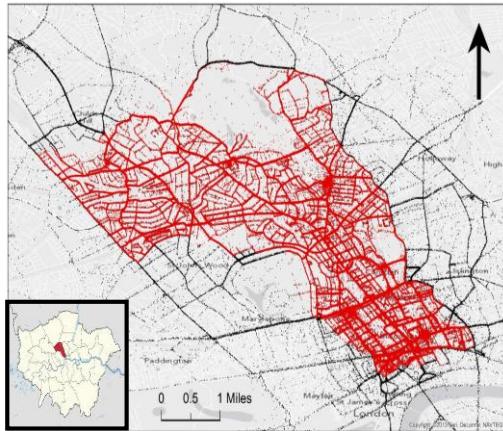
Policing

Citizenship

# Analysing and modelling police vehicle routes

## (Kira Kempinska)

By comparing models with GPS vehicle data, we gain insight into the nature of the route selection criteria followed by officers.



# Crime

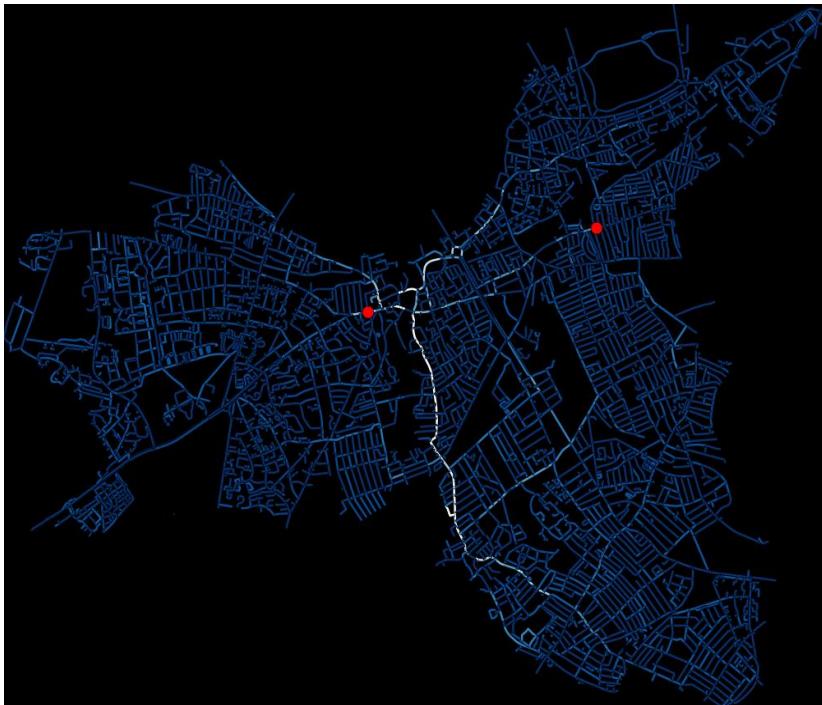
## Policing

# Citizenship

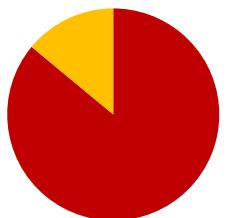
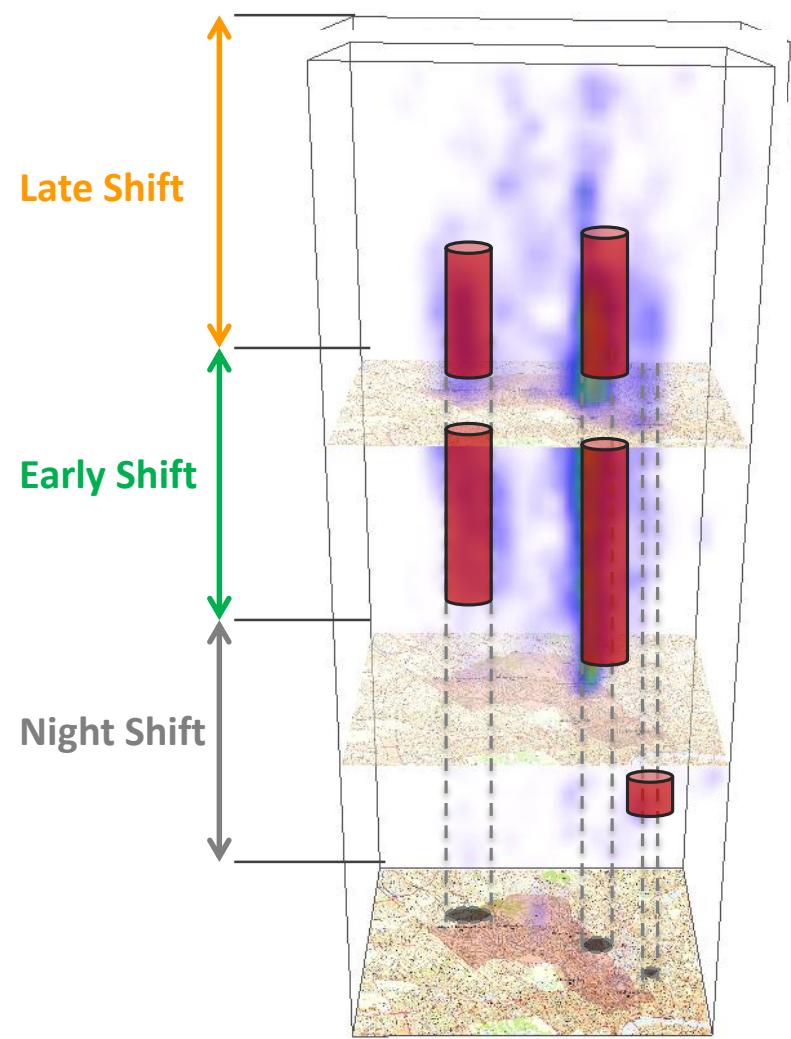
# Feedback - Supply vs demand (Toby Davies)

# Streets over-patrolled

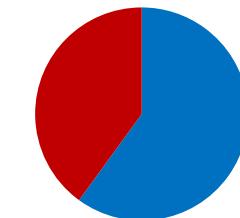
# Streets under-patrolled



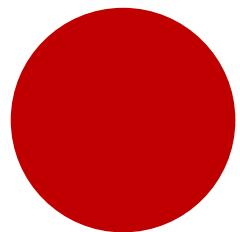
# Evaluation - Behaviour and pattern analysis (Jianan Shen)



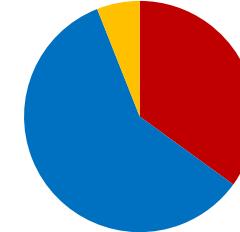
Officer subgroup I



Officer subgroup II

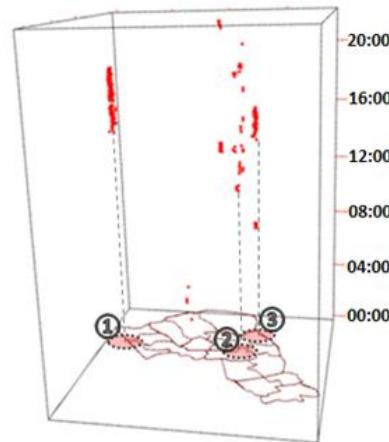


Officer subgroup III

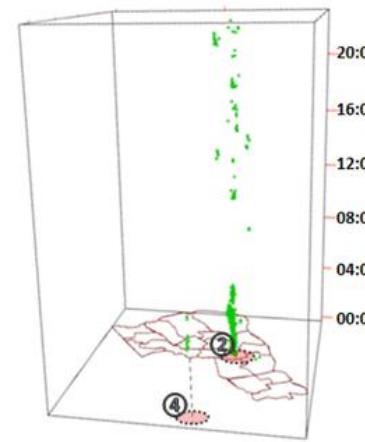


Officer subgroup IV

- FP
- CSO
- SO



Officer subgroup I



Officer subgroup II

FP: Foot patrol officer  
 CSO: Community support officer  
 SO: Senior officer

- ①Underground Station
- ②Central Camden
- ③Underground Station
- ④Embassy Area

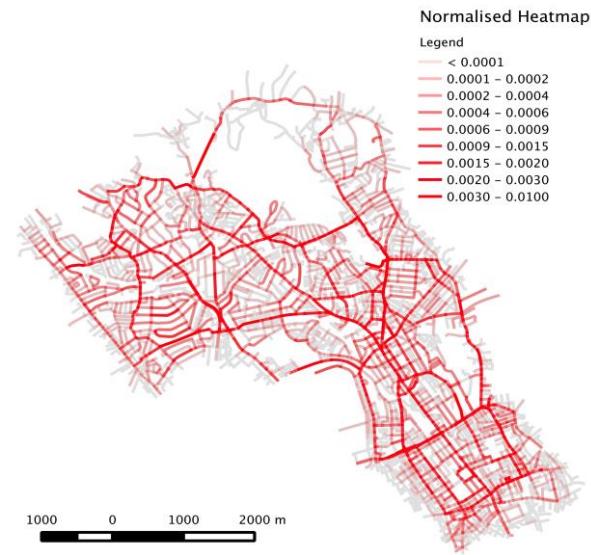
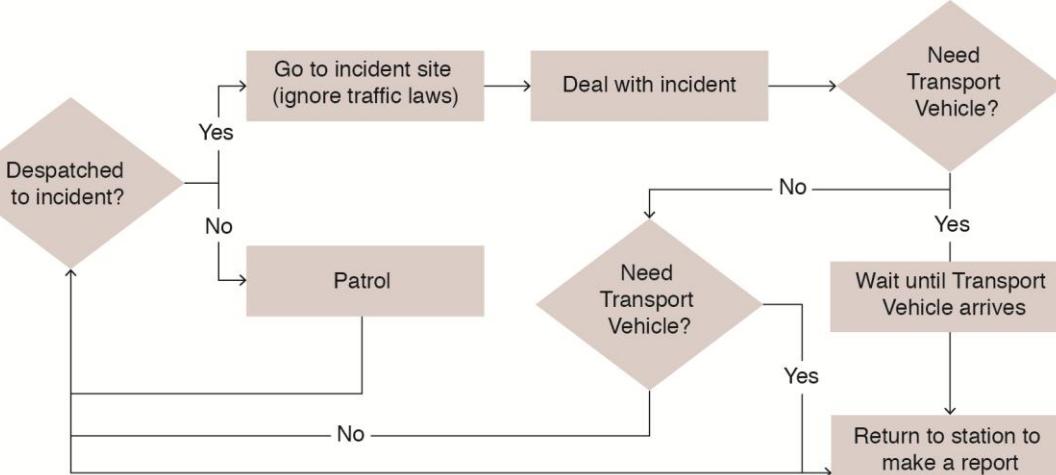
Crime

Policing

Citizenship

## Simulating police officers for scenario investigation (Sarah wise)

A realistic agent-based simulation has been developed that models the actions of patrolling officers on real street networks in response to crimes. This enables detailed scenario testing.

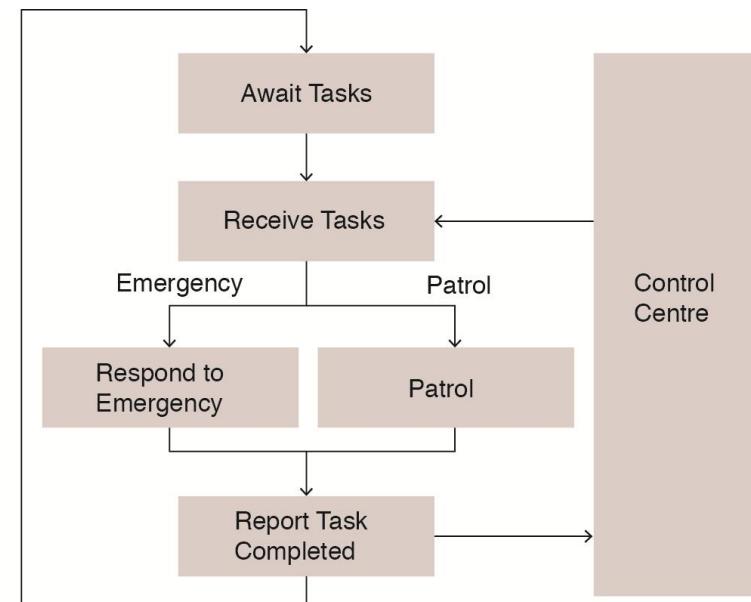
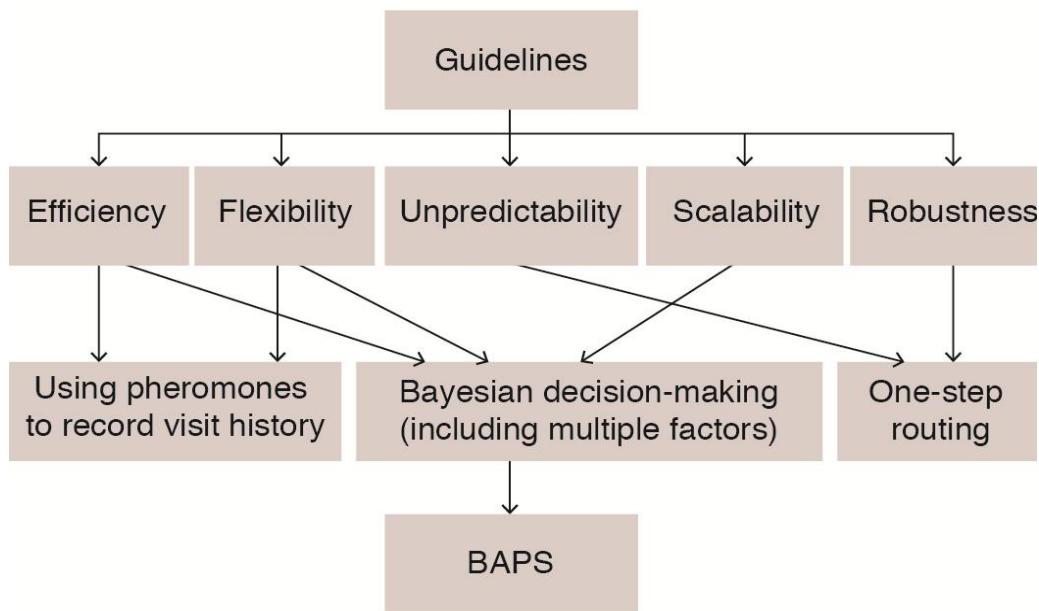


Crime

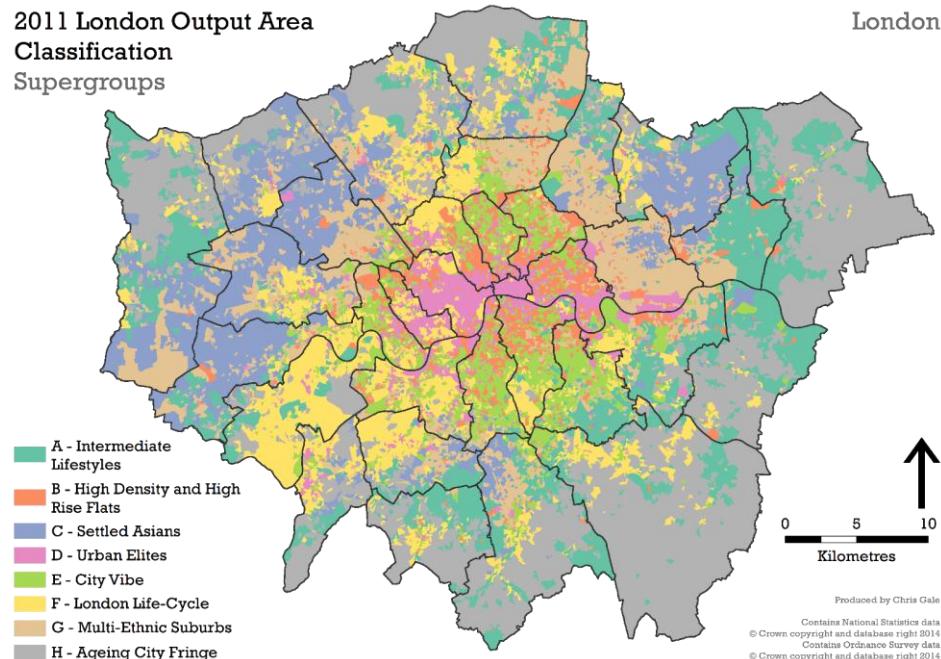
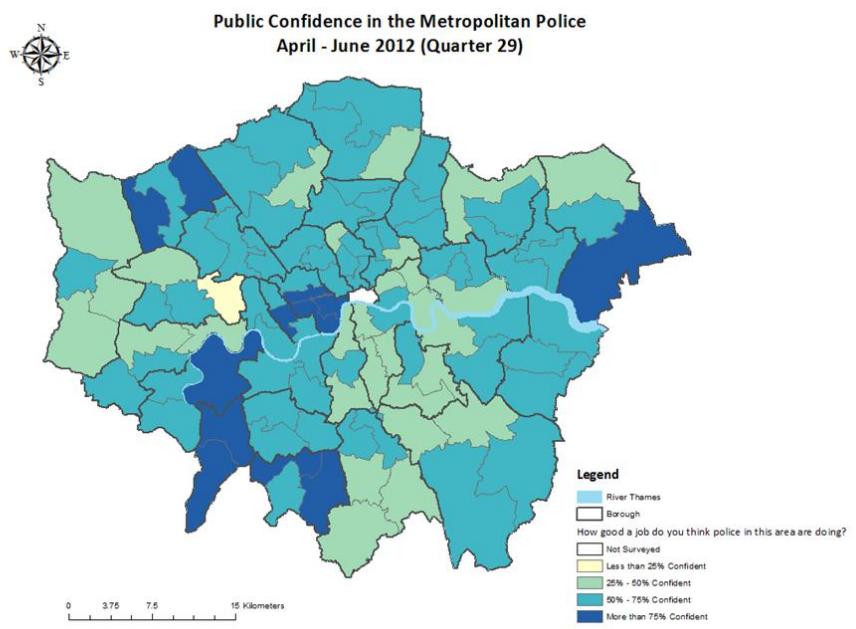
Policing

Citizenship

# An Online Cooperative Patrol Strategy (Huanfa Chen)

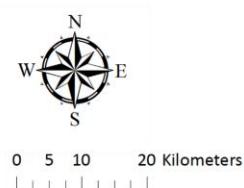
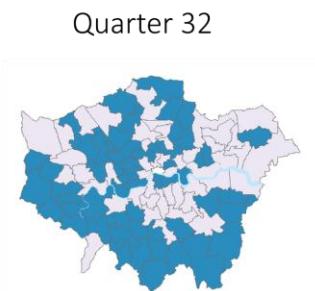
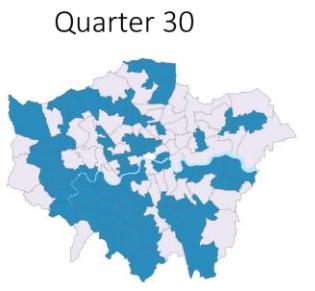


# Public confidence in the police using geodemographics and key questions from the PAS (Chris Gale)

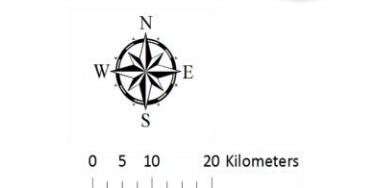
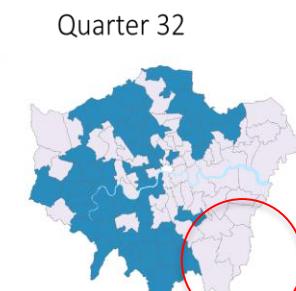
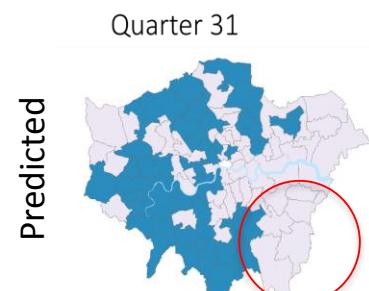
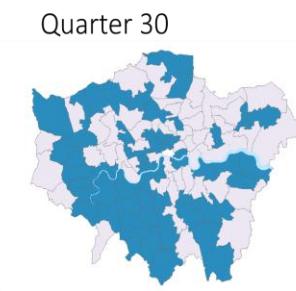
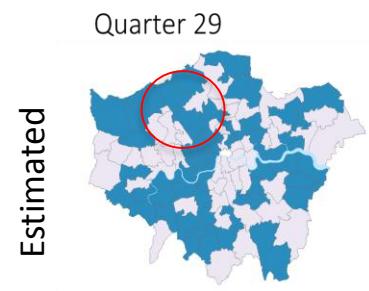


# Small area estimation of public confidence using PAS (Dawn Williams)

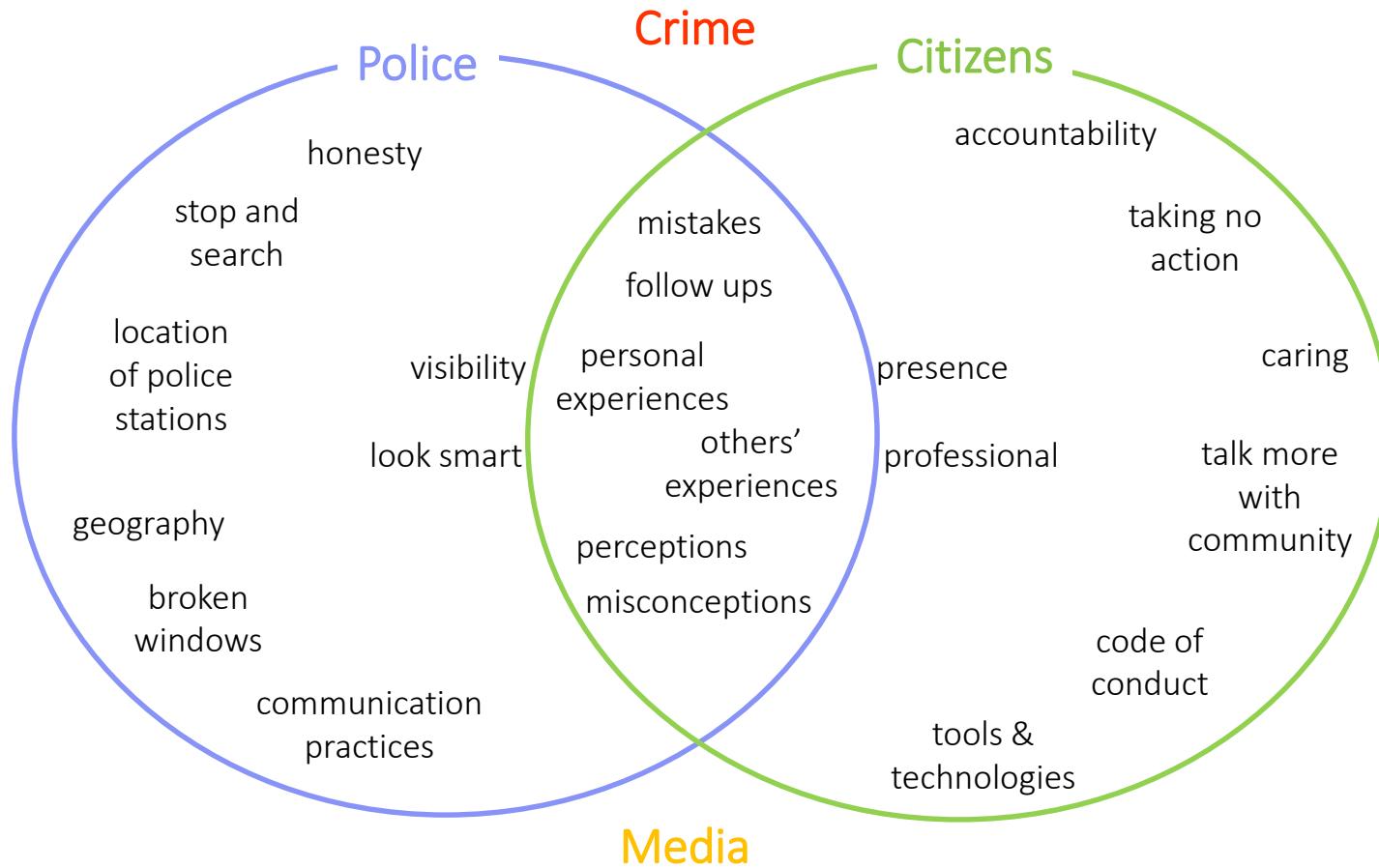
Empirical public confidence levels



Estimated and predicted public confidence levels



# Trust & confidence in policing - mental model approach (Artemis Skarlatidou)



# Policy Implications (CPC Report)

## Policy Goal: improve public confidence in policing

To reappraisal of existing survey instruments, development of new ones, and greater efforts to explain methods and achieve ‘buy in’ from front line officers

**Policy Goal: reduce costs and improve efficiency (“do more for less”)**

The prototype tools developed in CPC need to be completed and implemented as a viable operation products so that they can be widely adopted.

## Policy Goal: Crime reduction and prevention

To encourage frontline officers to accept the concept of intelligent patrol, and to use the network-based predictive maps to supplement their own experience of where and when it is best to patrol.

# Summary

- Policing is facing great challenges and opportunities.
- A paradigm shift is required to capitalise on the value of Big Data for intelligent policing.
- Intelligence is not only about prediction, but also how to act on it, and how to evaluate the action.
- This requires **behaviour change** from senior and frontline officers in order to use the insights from police data, as part of wider adoption of evidence-based policing.
- Adoption of the tools developed here requires **training**, but also a greater **openness** to the core organising concepts of predictive policing.
- The policy implications specifically set out here will benefit digital policing, not only in London, but in other large cities across the UK and beyond.

# Low-tech or high-tech coppers?

36 Britain

Policing crime

## Low-tech coppers

**Britain's separate police forces should make much better use of technology**

**B**RITISH bobbies are looking rather blue these days. Their budget may be cut by as much as 25-40%. Crime has fallen, but officers' workload has not. According to the Metropolitan Police, some four-fifths of calls that they take are not to do with crime but require close attention even so. And those offences that have increased in frequency, such as domestic violence, need particularly careful handling. But whereas forces around the world make better use of technology, Britain's lag behind.

One problem is that police computers are so out of date. Each year the police waste £22m (£\$342m) because they cannot access systems and records once they step outside the station, according to a study by the Centre for Economic and Business Research, a think-tank. A review of London's Metropolitan Police described a mishmash of 750 computer systems, "wired together over the last 40 years". One core operating process, it found, was based on "a 1970s baggage handling system". Police could get better deals on new technology as well. In September Theresa May, the home secretary, said that savings from better procurement methods might be worth as much as £75m a year.

There is an even bigger hitch, says Tim Newburn of the London School of Economics: that the 43 forces of England and Wales are bad at sharing data with each other. It has been 12 years since an inquiry into the murder of two schoolgirls recom-

mended that the forces improve their co-operation, but since then most have barely begun to do so.

Between 2007 and 2009 Surrey police found that they could not get hold of Metropolitan Police intelligence, which damaged an investigation into sexual abuse by Jimmy Savile, a television personality. Reports in February suggested that Welsh police had failed to catch a triple-murderer because his criminal record was held by another force. America does better, says Martin Innes at Cardiff University, probably because it has to: the country has many small police forces that have needed to learn to share information.

Britain has also been slow to take up new software that crunches crime data in order to predict where offences might happen. These are designed to save police time and money, as patrols can be targeted more precisely. Some are fairly old: one piece of software that narrows down suspects by spotting patterns in criminal activity was first developed in 1997. LexisNexis, the company that owns it, says areas where it has been tried out have seen a 46% reduction in crime. Nearly 500 police districts in America are now using it.

Even when Britain's police forces use these tools, they do not use them well. In 2013 Kent started using crime-prediction software from an American company called Predpol. The company's website boasts that between 2013 and 2014 crime went down by around 10% in two precincts in Atlanta which were using Predpol technology, but went up or stayed flat in four precincts that were not. Yet in 2013-14 crime in Kent went up by 11%. The trouble, according to the chief constable, was that the police were not going where Predpol told them to. Lawrence Sherman, at Cambridge University, says that police forces could be using GPS to check that officers are going to

The Economist October 17th 2015

the right areas. Trinidad and Tobago has successfully tried this.

There are some signs of change. South Yorkshire and Humberside police, along with Cambridgeshire Constabulary, are making their technology more mobile. Each force now expects that this will save its officers around a quarter of a million hours a year. The College of Policing recently trained 5,000 officers in retrieving intelligence from digital sources. Better late than never. ■

### International development

## Better to give

**Britain is the biggest foreign aid donor in the EU**

**A**T THE Tory party conference in Manchester, David Cameron proudly touted his promise to spend 0.7% of national income on foreign aid. Overseas aid has been a feature of Mr Cameron's conference speeches since 2010. Yet a growing economy and shrinking public spending elsewhere means a rising share of government spending goes on aid, to the annoyance of other cash-strapped departments. Since 2010, the aid budget has risen by 40%. Only America disburses more. Has the money been spent well?

The increased budget has been a boon for multilateral organisations. Some 62% of Department for International Development (DfID) spending now goes to such bodies, up from 56% in 2009. They are a useful way to spend money fast. But they are also good at operating on a large scale and are insulated from short-term political considerations. Getting multilateral organisations to hand out money frees DfID staff to focus on policy improvements, says Owen Barder, of the Centre for Global Development, a think-tank. And although some are not as effective as DfID, others are more so. The World Bank's development arm, the International Development Association (IDA), where 24% of British multilateral aid goes, "is probably the best aid agency in the world," says Mr Barder.

Although critics point out that such orga-



**"Even when British's police forces use these tools, they do not use them well."**

**"The trouble, ..., was that police were not going where Predpol told them to."**

# Integrated Tools for Intelligent Policing



The screenshot displays the 'Integrated Platform for Crime, Policing and Citizenship' interface. It features three main horizontal sections with red headers:

- CRIME PREDICTION APPLICATIONS**: Shows a hand pointing at a map with a red circle, labeled Crime Prediction.
- INTELLIGENT PATROL APPLICATIONS**: Shows a police car, labeled Intelligent Patrol.
- PERFORMANCE EVALUATION APPLICATIONS**: Shows two images: one of police officers in high-visibility jackets and another of a map with colored pins (red, green, blue), labeled Map-matching. It also shows a scale, labeled Patrol supply & demand.